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Foreword

Supply, use and input-output tables offer the most detailed portrait of an economy. They provide a detailed analysis of the process of production and the use of goods and services (products) and the income generated in that production. The tables are more complex than most other statistics and their compilation is challenging. But the benefits are large in many ways despite the required efforts. Supply and use tables provide, in addition, a consistent framework for balancing national accounts. In the core of the accounting system they render noticeable effects on quality and stability of the statistical results. Supply and use tables in combination with input-output tables constitute the appropriate basis for many different types of economic analysis. The scope for their exploitation is remarkably diversified.

By publishing this Manual, Eurostat is closing a gap for the European System of Accounts (ESA 1995). Already in 2002, when the first tables according to the ESA 1995 transmission programme were delivered to Eurostat, an initial version of this document had been drafted by a group of European experts.

In recent years the interest in supply, use and input-output tables has seen an impressive resurgence. With the globalisation of economic activities, many analysts have rediscovered the great utility of these specific statistics for several purposes of policy advice. Some examples of applications are highlighted in this document – environmental effects in the context of sustainable development, tables on physical flows, extended monetary tables or social accounting matrices. The list could easily be extended.

The strategic objective of this publication is to enhance the statistical basis in this area. The Eurostat Manual intends to ease the compilation of supply, use and input-output tables, foster quality and stimulate harmonisation of methods. The main emphasis of the Manual is to describe the methodologies and procedures for the compilation of supply, use and input-output tables in the European Union.

The present version is consequently derived from the 2002 draft; it further elaborates intelligibility and transparency. The theoretical explanation of the compilation steps is accompanied by a complete set of empirical tables, which illustrates the recommendations using real data. Boxes examine special issues in more detail and flow diagrams visualise concepts and interrelations. Moreover, various numerical examples provide an easy access to the complex compilation procedures.

The most important objective of the Manual is to provide guidance for national accountants who are engaged to establish an input-output framework for their economy according to international standards. Therefore, the Manual needs to be detailed and comprehensive. Due to its clear focus on the practical implementation, the Eurostat Manual complements SNA 1993 and ESA 1995 as well as the United Nations' Handbook of Input-Output Table Compilation and Analysis' of 1999. For national accounts experts the Eurostat Manual may serve as reference book. Finally, interested data users may also benefit from this publication as a source of background information and clarification.

March 2008

Laurs Nørlund
Director

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At Eurostat Peter Ritzmann acted as chief editor for the document, assistance was provided by Gerard Hanney and Joseph Heuschling.

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1.1 Introduction

Supply and use tables are an integral part of the European System of Accounts (ESA 1995). They play an important role as an integration framework of the national accounts. The ESA 1995 is fully consistent with the world-wide System of National Accounts (SNA 1993). However, the ESA is focussed more on the circumstances and data needed in the European Union. As a key feature of national accounts, supply and use tables provide the ideal concept for balancing supply and demand. The supply and use system is the best framework for compiling both GDP at current and at constant prices in an integrated approach. Supply and use tables constitute the centre piece of the internationally compatible accounting framework for a systematic and detailed description of the economy, its various components on the supply and demand side and its relations to other economies.

The input-output framework of the European System of Accounts (ESA 1995) consists of three types of tables:

- supply tables,
- use tables and
- symmetric input-output tables.

These types of data sets form the input-output framework as described in Chapter 9 of the ESA 1995. For the tables the same concepts and definitions apply as for the whole system of accounts. The integration of supply and use tables in the ESA 1995 is a new feature of the system. In the ESA 1979 only symmetric input-output tables were included as part of the system.

Supply and use tables provide a detailed picture of the supply of goods and services by domestic production and imports and the use of goods and services for intermediate consumption and final use (consumption, gross capital formation, exports). The use table also shows how the components of value added (compensation of employees, other net taxes on production, consumption of fixed capital, net operating surplus) are generated by industries in the domestic economy. Thus, supply and use tables give detailed information on the production processes, the interdependencies in production, the use of goods and services and generation of income generated in production. After balancing supply and use table provide coherent data linking industries, products and sectors.

The supply and use framework enables detailed analysis of industries and products through a breakdown of the production account, the goods and services account and the generation of income account. These tables show the structure of the costs of production and income generated in the production process, the flow of goods and services produced within the national economy, and the flows of goods and services with the rest of the world.

The classifications in the symmetric input-output tables coincide with those in the supply and use tables, as the former is a transformation of the latter. The symmetric input-output table is accompanied by a symmetric input-output table for domestic output and a matrix showing the use of imports. The classifications are totally compatible with those used within the framework of the United Nations.

The supply and use tables and input-output tables of the ESA 1995 relate products and industries. The classification used for industries is the 'General Industrial Classification of Economic Activities within the European Communities' (NACE) and the classification employed for products is the 'Classification of Products by Activity' (CPA). These classifications are fully aligned to each other. At each level of aggregation, the CPA shows the principal products of the industries according to the NACE[1].

The supply and use tables also form the basis for deriving symmetric input-output tables by applying certain assumptions to the relationship between outputs and inputs. Symmetric input-output tables are the basis for input-output analysis.

The supply and use framework is that part of the national accounts system which focuses on the production in an economy. It reflects the production of industries in which intermediate products and primary inputs (labour, capital, land) are required. Supply and use tables show where goods and services are produced and where they are used in intermediate consumption, final consumption, gross capital formation and exports. The supply and use framework provides the most

[1] At the publication of this release of the manual NACE Rev.1.1 and CPA 2002 were applied for supply, use and input-output tables.

important macroeconomic aggregates such as GDP, value added, consumption, investment, imports and exports. The supply and use system is the adequate accounting framework for compiling consistent and reliable national accounts data. In consequence, it is recommended that the compilation of national accounts data - both in current prices as well as in constant prices - should be based on a supply and use framework.

Supply and use tables provide an ideal framework for checking the consistency of statistical data on flows of goods and services obtained from different sources. They also serve as a framework for economic statistics, both conceptually for ensuring the consistency of definitions and concepts used and as an accounting framework for ensuring numerical consistency of data obtained from different sources. The framework also allows basic economic data to be entered into the system in exactly the same structure in which the basic data can be surveyed and observed.

In addition to the roles of the supply and use framework mentioned above, this accounting framework serves also as a basis for various interconnections with satellite accounts, such as Social Accounting Matrix (SAM), employment statistics, linkages with physical flows (land use, energy), linkages with other physical flows related to environmental issues (emissions, waste, sewage) and other forms of satellite systems for tourism, transport, health and education.

1.2 Outline of the supply and use system

The supply table and the use table constitute the core of the supply and use system. A simplified supply table is shown in Table 1.1. The supply table is a product by industry based table with products in the rows and industries and imports in the columns.

A supply table shows the supply of goods and services by product and by type of supplier, distinguishing supply by domestic industries and imports from those of other countries. In the production matrix (transposed make matrix) the domestic output of industries is shown by products. The vector of imports is lists total imports of the nation by product.

Table 1.1: A simplified supply table

Industries / Products	Industries			Imports	Total
	Agriculture	Industry	Service activities		
Agricultural products Industrial products Services	Output by product and by industry			Imports by product	Total supply by product
Total	Total output by industry			Total imports	Total supply

The last row of the supply table shows total output by industry, total imports and total supply. In the last column of the supply table, total supply by product is reported consisting of domestic and imported products.

Primary (main) activities of industries are reported on the diagonal of the production matrix while secondary activities of industries are reported off the diagonal (see example in Box 1.1). As each industry can produce not only products characteristic for that industry but also other products, the production matrix of domestic output has not only data entries on the main diagonal. The production of products characteristic for an industry is called primary output, while the production of other products not characteristic for this industry is called secondary output.

In order to distinguish between primary and secondary output of an industry, a relation between industries and products has to be defined based of the criteria of industrial origin. Each product is related to one industry which by definition is the primary producer of that product. Thus, each industry can be defined by the list of primary products that are attributed to that industry. For example, butter is a primary product of the dairy industry, as well as processed liquid or solid milk, cream, yoghurt, cheese and other dairy products. Production of these products in the dairy industry would be the primary output of products, and the production of non-dairy products (such as non-dairy food products, construction or restaurant services) would be the secondary output. Similarly, the production of dairy products in other industries would be their secondary output.

For the compilation of supply and use tables, the relationships between industries and characteristic products need not to be elaborated specifically. The applied European classifications (NACE and CPA) are already structured upon that principle. Furthermore, the classifications show this relationship directly in their coding system.

The share of secondary outputs varies across industries. Some industries may only have primary outputs, while others will have a considerable amount of secondary outputs. Secondary outputs are usually smaller than primary outputs as units are classified according to their main activity. However, the size of secondary outputs also depends on the level of aggregation. A greater disaggregating level of the supply table shows a higher degree of secondary output, and vice versa. The size of secondary output also depends on the statistical unit that is used. In the case of enterprises, the secondary output will be much more frequent and higher in its output share than when the information is directly collected from local kind-of-activity units. The local kind-of-activity unit is the best alternative as smallest statistical unit for the supply and use tables. However, even if local kind-of-activity units are used, secondary outputs will still be present.

In supply and use tables the classification of products can be more detailed than the classification of industries. In this case the supply and use system is rectangular with more products than industries. If the classification of products is only as detailed as the classification of the industries, the system has a square format. For example, the output of the dairy industry could be separately shown in the supply and use tables for the products of processed milk, butter, yoghurt, and cheese or only as one aggregate product for all dairy products.

The supply table in Table 1.1 is simplified in many ways. It does not specify the classification of industries and products, it does not distinguish between market producers and producers for own final use and other non-market producers, it does not indicate any subdivisions of the imports by geographical regions, it does not specify the valuation of domestic output and imports and it does not include any adjustment items reflecting trade and transport margins nor taxes and subsidies on products.

The simplified use table in Table 1.2 can be subdivided into three tables:

- Table of intermediate use
- Table of final uses
- Table of value added

The use table is a product by industry based table with products and components of value added in the rows and industries, categories of final uses and imports in the columns. A use table shows the use of goods and services by product and by type of use, i.e. as intermediate consumption by industry, final consumption, gross capital formation or exports. Furthermore, the table shows the components of value added by industry, i.e. compensation of employees, other taxes less subsidies on production, consumption of fixed capital and net operating surplus.

The table of intermediate use shows the intermediate consumption by products and by industry, the table of final uses shows the uses of products for final consumption, gross capital formation and exports, and the table of value added shows the components of value added by industry. Totals over the columns of intermediate and final uses show total use by products, totals over the rows of the intermediate table and the value added table identify total inputs by industries.

The columns of industries in the use table reflect the cost structure of each specific industry. The intermediate consumption table thus identifies goods and services that are necessary to produce the primary and secondary outputs of industries. This table has many more entries than the output matrix as some products are required in many industries to produce their output. For example, electricity is a product that is required in more or less all industries. On the other hand, there are certain products that are only be required in one or few industries. An example is crude oil which is only used in refineries.

Table 1.2: A simplified use table

<table>
<tr><th rowspan="2">Industries / Products</th><th colspan="3">Industries</th><th colspan="3">Final uses</th><th rowspan="2">Total</th></tr>
<tr><th>Agriculture</th><th>Industry</th><th>Service activities</th><th>Final consumption</th><th>Gross capital formation</th><th>Exports</th></tr>
<tr><td>Agricultural products
Industrial products
Services</td><td colspan="3">Intermediate consumption by product and by industry</td><td colspan="3">Final uses by product and by category</td><td>Total use by product</td></tr>
<tr><td>Value added</td><td colspan="3">Value added by component and by industry</td><td colspan="3"></td><td>Value added</td></tr>
<tr><td>Total</td><td colspan="3">Total output by industry</td><td colspan="3">Total final uses by category</td><td></td></tr>
</table>

In the intermediate consumption table there is no differentiation between goods and services that are required to produce primary outputs and those that are needed for the production of secondary outputs. Such a differentiation is in most cases not feasible to collect. In most cases a direct attribution of intermediate inputs to various output products can not be provided by the respondents. This especially holds true for overhead costs. However, it should be noted that in the supply and use framework such a differentiation is not necessary at all.

The relationships between the inputs required for the various outputs are the key issue for the derivation of symmetric input-output tables. In this derivation procedure the input-output relations are modelled on the basis of analytical assumptions.

For compiling the intermediate use table, the same statistical unit should be used as for compiling the supply table, preferably the local kind-of-activity unit. Compared to data from enterprise units (institutional unit), the data achieved from local kind-of-activity units will be more homogeneous with respect both to their outputs and to their inputs.

Between supply and use tables, two types of identities hold. In the supply table (Table 1.1) and the use table (Table 1.2) total output by industries is equal to total input by industries and total supply by products is equal to total uses by products (see also example in Box 1.1). The balancing process should not be limited to the supply and use tables at current prices. The compilation of supply and use tables at current and constant prices for a sequence of years will help to balance the changes in volumes, values and prices in the best possible way.

As in the supply table, the classification of products in the intermediate and final use tables can be more detailed than the classification of industries. However, the same level of detail for products should be used for the use table as for the supply table. The categories of final uses can also be shown in more detail than in the simplified Table 1.2. For example, gross capital formation can be blown up to an investment matrix identifying the producing and investing industries of capital goods, final consumption disaggregated to individual consumption by purpose (COICOP), or exports given by geographical regions.

In the value added table several components of value added are shown, such as the compensation of employees, other net taxes on production, consumption of fixed capital, and net operating surplus. Depending on the price concept of supply and use tables, taxes and subsidies on products need to be shown in addition.

The simplified use table does not distinguish the use of goods and services that were produced domestically from the use of goods and services that were imported. This also reflects the fact that data sources used for the compilation of the use table do not normally differentiate between the origin of the goods and services. However, for analytical purposes such a distinction is of great importance and the compilation of separate import matrices is part of the system.

Box 1.1: Supply and use framework

Supply table

Products \ Industries	Industries			Imports	Total
	Agricul-ture	Industry	Service activities		
Agricultural products	270	30	50	20	370
Industrial products	10	430	100	50	590
Services	20	40	550	30	640
Total	300	500	700	100	1 600

Use table

Products \ Industries	Industries			Final uses			Total
	Agricul-ture	Industry	Service activities	Final consump-tion	Gross capital formation	Exports	
Agricultural products	34	59	143	81	21	32	370
Industrial products	106	119	77	123	103	62	590
Services	70	112	75	291	61	31	640
Value added	90	210	405				705
Total	300	500	700	495	185	125	

Supply and use framework

		Products			Industries			Final uses			Total
		Agri-cultural products	Industrial products	Services	Agricul-ture	Industry	Service activities	Final con-sumption	Gross capital formation	Exports	
Products	Agricultural products				34	59	143	81	21	32	370
	Industrial products				106	119	77	123	103	62	590
	Services				70	112	75	291	61	31	640
Industries	Agriculture	270	10	20							300
	Industry	30	430	40							500
	Service activities	50	100	550							700
Value added					90	210	405				705
Imports		20	50	30							100
Total		370	590	640	300	500	700	495	185	125	

Supply and use tables are product by industry tables.

The *supply table* shows the supply of goods and services by product and by type of supplier. It is comprised of output of domestic industries and total imports by product. The supply table contains the production matrix of domestic industries and the vector of total imports.

The *use table* shows the use of goods and services by product and by type of use, i.e. as intermediate consumption of industries, final consumption, gross capital formation and exports. It also contains the components of value added by industry, i.e. compensation of employees, other taxes less subsidies on production, consumption of fixed capital and net operating surplus.

The *supply and use framework* integrates the supply table and the use table in one matrix. In the framework, the production matrix of the supply table is transposed to the make matrix, and the vector of imports of the supply table is transposed to a row vector of imports.

Product data for compiling the intermediate and final use tables will be available in a different valuation than the data for the production matrix of the supply table. The valuation of the output data will be based on prices at which the products were sold, whereas the valuation of the product data for the compilation of the use tables will be based on the prices that had to be paid by the purchaser of the products. The difference between these valuation concepts are due to the services of trade and transport between the seller of a product and the user of that product and due to the taxes and subsidies on products. In order to achieve a uniform valuation, specific valuation matrices have to be elaborated for trade and transport margins and taxes and subsidies on products.

The accounting framework of supply and use tables was designed in such a way that it becomes clear that the accounting framework is fully appropriate to the way output and input data can be observed and collected. The economic units (local kind-of-activity units) can report their output subdivided by primary and secondary products and they also can report their intermediate consumption subdivided by products for their entire activity. However, in most cases they cannot report their requirements for intermediate inputs subdivided whether they have been used for the production of primary products or for the production of secondary products. For some inputs this may be possible (for example, raw materials), but not for most of the other required inputs (especially not for overhead costs). Fortunately, in a supply and use framework such a differentiation is not required.

As the supply table in Table 1.1, the use table in Table 1.2 is simplified in many ways. It does not specify the classifications of industries and products; it does not distinguish between market producers, producers for own final use and other non-market producers; it does not subdivide between the use of domestically produced and imported products and it does not specify the valuation of the use data.

The separate supply and use tables can also be integrated in one framework. The simplified version of the supply and use system is shown in Table 1.3. In this combined form, the two main identities of the system can be clearly seen. In the combined form of the supply and use framework, the production matrix (product by industry table) of Table 1.1 has been transposed to the corresponding make matrix (industry by product table) and the import column of the supply table to a row vector.

As mentioned above, for both the industries and the products, the following identities can be observed:

- Output by industry = Input by industry
- Total supply by product = Total use by product.

Each industry output is equal to the sum of intermediate consumption plus value added. For each product, supply (output plus imports) equals the sum of intermediate consumption, final consumption, gross capital formation and exports.

Table 1.3: A simplified supply and use framework

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="3">Products</th><th colspan="3">Industries</th><th colspan="3">Final uses</th><th rowspan="2">Total</th></tr>
<tr><th>Agri-cultural products</th><th>Industrial products</th><th>Services</th><th>Agri-culture</th><th>Industry</th><th>Service activities</th><th>Final con-sumption</th><th>Gross capital formation</th><th>Exports</th></tr>
<tr><td rowspan="3">Products</td><td>Agricultural products</td><td colspan="3" rowspan="3"></td><td colspan="3" rowspan="3">Intermediate consumption by product and by industry</td><td colspan="3" rowspan="3">Final uses by product and by category</td><td rowspan="3">Total use by product</td></tr>
<tr><td>Industrial products</td></tr>
<tr><td>Services</td></tr>
<tr><td rowspan="3">Industries</td><td>Agriculture</td><td colspan="3" rowspan="3">Output of industries by product</td><td colspan="3" rowspan="3"></td><td colspan="3" rowspan="3"></td><td rowspan="3">Total output by industry</td></tr>
<tr><td>Industry</td></tr>
<tr><td>Service activities</td></tr>
<tr><td colspan="2">Value added</td><td colspan="3"></td><td colspan="3">Value added by component and by industry</td><td colspan="3"></td><td>Total value added</td></tr>
<tr><td colspan="2">Imports</td><td colspan="3">Total imports by product</td><td colspan="3"></td><td colspan="3"></td><td>Total imports</td></tr>
<tr><td colspan="2">Total</td><td colspan="3">Total supply by product</td><td colspan="3">Total output by industry</td><td colspan="3">Total final uses by category</td><td></td></tr>
</table>

= not applicable

Box 1.2: Supply and use tables for domestic production and imports

Supply table

Products \ Industries	Industries			Domestic supply	Imports	Total
	Agricul-ture	Industry	Service activities			
Agricultural products	270	30	50	350	20	370
Industrial products	10	430	100	540	50	590
Services	20	40	550	610	30	640
Total	300	500	700	1 500	100	1 600

Use table for domestic production

Products \ Industries	Industries			Final uses			Total
	Agricul-ture	Industry	Service activities	Final con-sumption	Gross capital formation	Exports	
Agricultural products	30	50	140	80	20	30	350
Industrial products	90	100	70	120	100	60	540
Services	60	100	70	290	60	30	610
Imports CIF	30	40	15	5	5	5	100
Value added	90	210	405				705
Total	300	500	700	495	185	125	

Use table for imports

Products \ Industries	Industries			Final uses			Total
	Agricul-ture	Industry	Service activities	Final con-sumption	Gross capital formation	Exports	
Agricultural products	4	9	3	1	1	2	20
Industrial products	16	19	7	3	3	2	50
Services	10	12	5	1	1	1	30
Total	30	40	15	5	5	5	100

The *supply table* identifies in the production matrix the domestic supply of industries by product. The two column vectors for domestic supply and imports represent total supply of products.

The *use table of domestic production* was derived by subtracting the use table of imports from the total use table of Box 1.1. It identifies the input requirements of industries in terms of domestic intermediates, imported intermediates and primary inputs (value added). It also identifies the use of domestic products for intermediate uses and final uses.

The *use table of imports* includes information on the use of imported products for intermediate consumption and final uses.

A small numerical example for the main elements of the ESA 1995 input-output framework is presented in four boxes. In Box 1.1 the supply and use framework is given for the numerical example. In **Box 1.2** the use table is separated into a use table for domestic production and a use table for imports. In Box 1.3 the corresponding input-output tables are presented in a product by product classification. In Box 1.4 the corresponding input-output tables are included in an industry by industry classification.

1.3 Outline of symmetric input-output tables

The supply and use tables serve not only statistical but also analytical purposes, especially when the supply and use tables are transformed into symmetric input-output tables. As mentioned above, the intermediate consumption table shows for each industry the use of goods and services which were necessary to produce the primary and the secondary outputs of an industry. For analytical purposes, assumptions about the relations between inputs and outputs are required irrespective of whether the products have been produced by the primary industry or by other industries as their secondary output.

Compiling input-output tables is an analytical step. For the transformation of supply and use tables into symmetric input-output tables, various assumptions have to be made and sometimes adjustments are required. The format of symmetric input-output tables can either be made on the basis of an industry by industry or product by product classification.

Transforming supply and use tables into symmetric input-output tables can be based on the following four basic assumptions.

Product by product input-output tables

- *Product technology assumption (Model A)*
  Each product is produced in its own specific way, irrespective of the industry where it is produced.
- *Industry technology assumption (Model B)*
  Each industry has its own specific way of production, irrespective of its product mix.

Industry by industry input-output tables

- *Fixed industry sales structure assumption (Model C)*
  Each industry has its own specific sales structure, irrespective of its product mix.
- *Fixed product sales structure assumption (Model D)*
  Each product has its own specific sales structure, irrespective of the industry where it is produced.

The first two assumptions can be applied to compile product by product input-output tables. The product technology assumption (Model A) assumes that each product has its specific technology, irrespective of the industry that produces that product. The industry technology assumption (Model B) assumes that each industry has its specific technology (in terms of inputs), irrespective of the product mix of that industry. A mixture of both assumptions can also be applied by implementing a hybrid technology assumption.

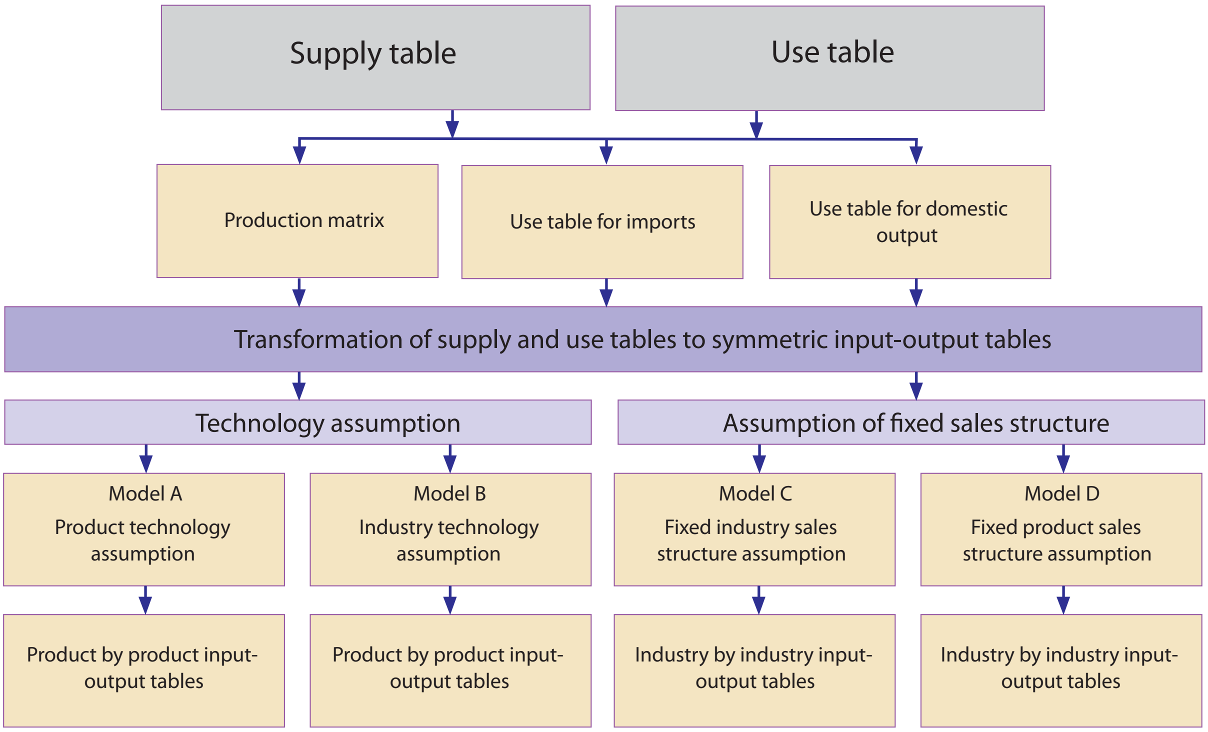
The transformation of supply and use tables to symmetric industry by industry input-output tables is based on assumptions on the sales structure. The fixed industry sales structure assumption (Model C) assumes that each industry has its own specific sales structure, irrespective of its product mix. The fixed product sales structure assumption (Model D) assumes that each product has its own specific sales structure, irrespective of the industry where it is produced.

The selection of the appropriate type of input-output tables (product by product vs. industry by industry) depends on the specific objective of economic analysis. The supply and use system offers a flexible solution. Industry by industry input-output tables are closer to statistical sources and actual market transactions. Product by product input-output tables are believed to be more homogenous in terms of cost structures and production activities.

If product by product input-output tables are compiled, theoretical considerations indicate that the 'Product technology assumption' (Model A) is preferable to the 'Industry technology assumption' (Model B). It is also acknowledged that the 'Fixed product sales structure assumption' (Model D) is more plausible than the 'Fixed industry sales structure assumption' (Model C) if the objective is to compile industry by industry input-output tables.

Input-output tables are analytical tables which have been derived from the supply and use system. The transformation of supply and use tables to input-output tables is visualised in Figure 1.1.

Figure 1.1: Transformation of supply and use tables to input-output tables



The transformation procedure converts the product by industry system of the supply and use tables into a product by product system or industry by industry system. In ESA 1995, compiling product by product input-output tales is promoted. A transformation of supply and use tables to symmetric input-output tables is not necessary if no secondary outputs are observed. In this case the intermediate consumption requirements are fully determined by the primary activity. In such a case the production matrix of the supply table has only data entries on the main diagonal and the use table is equivalent with an input-output table.

In Table 1.4 the product by product table is shown in a simplified form. The relations between output and input are now relations between products and primary inputs necessary to produce products in homogenous units of production.

Table 1.4: A simplified symmetric input-output table (product by product)

Products / Products	Homogeneous units of production			Final uses			Total use
	Agricultural products	Industrial prodcts	Services	Final con-sumption	Gross capital formation	Exports	
Agricultural products Industrial products Services	Intermediate consumption by product and by homogeneous units of production			Final uses by product and by category			Total use by product
Value added	Value added by component and by homogeneous units of production						
Imports for similar products	Total imports by product						
Supply	Total supply by homogeneous units of production			Total final uses by category			

In the case of an input-output table, the two types of identities in the supply and use system are now reduced to one type of identity. It is typical for symmetric input-output tables that for each product or industry input equals output and total supply equals total uses.

Total supply by product	=	Total use by product
Total input by product	=	Total output by product

The figures of total supply and total use by product are still the same as in the supply and use tables. The industry based structures are transformed into product based structures. In this transformation, the final use data are left unchanged. The transformation only rearranges on the basis of the production matrix the intermediate use table by applying certain analytical assumptions to the relations between primary and secondary outputs.

Box 1.3: Product by product input-output tables

Input-output table for domestic production (product by product)

Products / Products	Products			Final uses			Total output
	Agrcultural products	Industrial products	Services	Final consumption	Gross capital formation	Exports	
Agricultural products	31.77	47.81	140.42	80.00	20.00	30.00	350.00
Industrial products	112.44	110.42	37.14	120.00	100.00	60.00	540.00
Services	73.23	114.19	42.58	290.00	60.00	30.00	610.00
Imports CIF	37.73	46.07	1.20	5.00	5.00	5.00	100.00
Value added	94.83	221.51	388.66				705.00
Output	350.00	540.00	610.00	495.00	185.00	125.00	

Input-output table for imports (product by product)

Products / Products	Products			Final uses			Total import
	Agricultural products	Industrial products	Services	Final consumption	Gross capital formation	Exports	
Agricultural products	4.91	10.75	0.34	1.00	1.00	2.00	20.00
Industrial products	20.22	21.68	0.11	3.00	3.00	2.00	50.00
Services	12.60	13.65	0.74	1.00	1.00	1.00	30.00
Total	37.73	46.07	1.20	5.00	5.00	5.00	100.00

Input-output table of supply and uses (industry by industry)

Products / Products	Products			Final uses			Total use
	Agricultural products	Industrial products	Services	Final consumption	Gross capital formation	Exports	
Agricultural products	36.69	58.55	140.76	81.00	21.00	32.00	370.00
Industrial products	132.65	132.10	37.25	123.00	103.00	62.00	590.00
Services	85.83	127.84	43.33	291.00	61.00	31.00	640.00
Value added	94.83	221.51	388.66				705.00
Imports of similar products	20.00	50.00	30.00				100.00
Supply	370.00	590.00	640.00	495.00	185.00	125.00	

In *product by product input-output tables* all inputs are allocated to homogenous production units. They are derived from the supply and use system on the basis of analytical assumptions.

Product by product input-output tables are believed to be more homogenous but further away from statistical sources than industry by industry input-output tables.

A symmetric input-output table is a product by product or industry by industry matrix describing the domestic production processes and the transactions in products of the national economy in great detail. A symmetric input-output table rearranges both supply and use in a single table. The derivation of symmetric input-output tables from the system of supply and use tables will reveal inconsistencies and weaknesses in the supply and use system. In this respect, there is also a feedback from the symmetric input-output tables to the supply and use tables and vice versa.

Box 1.4: Industry by industry input-output tables

Input-output table of domestic production (industry by industry)

Industry / Industry	Industry			Final uses			Total output
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Agriculture	26.78	43.70	111.59	73.44	19.25	25.24	300.00
Industry	78.17	90.47	72.33	121.43	85.28	52.32	500.00
Service activities	75.05	115.83	96.08	295.13	75.47	42.45	700.00
Imports CIF	30.00	40.00	15.00	5.00	5.00	5.00	100.00
Value added	90.00	210.00	405.00				705.00
Output	300.00	500.00	700.00	495.00	185.00	125.00	

Input-output table of imports (industry by industry)

Industry / Industry	Industry			Final uses			Total imports
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Agriculture	3.71	7.69	2.61	0.86	0.86	1.61	17.34
Industry	13.74	16.69	6.16	2.54	2.54	1.83	43.50
Service activities	12.55	15.62	6.23	1.60	1.60	1.56	39.17
Total	30.00	40.00	15.00	5.00	5.00	5.00	100.00

Input-output table of supply and uses (industry by industry)

Industry / Industry	Industry			Final uses			Total uses
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Agriculture	30.49	51.39	114.20	74.30	20.11	26.85	317.34
Industry	91.91	107.16	78.49	123.97	87.82	54.15	543.50
Service activities	87.60	131.45	102.31	296.73	77.07	44.00	739.17
Value added	90.00	210.00	405.00				705.00
Imports of similar products	17.34	43.50	39.17				100.00
Supply	317.34	543.50	739.17	495.00	185.00	125.00	

In *industry by industry input-output tables* inputs are allocated to industries. They are derived from the supply and use system on the basis of pragmatic assumptions. The intermediate input of industries consists of output of industries rather than products.

Industry by industry input-output tables are less homogeneous but closer to statistical sources and actual observations than product by product input-output tables.

There is one major conceptual difference between a symmetric input-output table and a combined supply and use table. In supply and use tables, statistics relate products to industries, while in symmetric input-output tables, statistics relate products to products (homogenous production units) or industries (industry output) to industries. It is common for symmetric input-output tables that either a product or an industry classification is employed for both rows and columns.

New elements of supply and use tables are supplementary information for each sector on fixed capital formation, fixed capital stock and labour inputs (persons). This supplementary information provides a key link to productivity analysis. The supplementary data is added to use tables on an annual basis and sometimes even on a quarterly basis. In consequence, for each industry detailed information on all inputs (intermediates, value added) is given but also supplementary information on current investment capital and labour. In the future, the supplementary data can be extended to cover other environmental issues like energy, emissions and other residuals.

Box 1.5: Transformation of supply and use tables to input-output tables

Supply table

Products \ Industries	Industries			Imports	Total supply
	Agriculture	Industry	Service activities		
Agricultural products	270.00	30.00	50.00	20.00	370.00
Industrial products	10.00	430.00	100.00	50.00	590.00
Services	20.00	40.00	550.00	30.00	640.00
Total	300.00	500.00	700.00	100.00	1600.00

Use table

Products \ Industries	Industries			Final uses			Uses
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Agricultural products	34.00	59.00	143.00	81.00	21.00	32.00	370.00
Industrial products	106.00	119.00	77.00	123.00	103.00	62.00	590.00
Services	70.00	112.00	75.00	291.00	61.00	31.00	640.00
Total	210.00	290.00	295.00	495.00	185.00	125.00	1600.00
Value added	90.00	210.00	405.00				705.00
Output	300.00	500.00	700.00				1500.00

Product by product input-output table (Model A)

Products \ Products	Products			Final uses			Uses
	Agricultural products	Industrial products	Services	Final consumption	Gross capital formation	Exports	
Agricultural products	36.69	58.55	140.76	81.00	21.00	32.00	370.00
Industrial products	132.65	132.10	37.25	123.00	103.00	62.00	590.00
Services	85.83	127.84	43.33	291.00	61.00	31.00	640.00
Total	255.17	318.49	221.34	495.00	185.00	125.00	1600.00
Value added	94.83	221.51	388.66				705.00
Output	350.00	540.00	610.00				1500.00
Imports of similar products	20.00	50.00	30.00				100.00
Supply	370.00	590.00	640.00				1600.00

Industry by industry input-output table (Model D)

Industries / Industries	Industries			Final uses			Uses
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Agriculture	30.49	51.39	114.20	74.30	20.11	26.85	317.34
Industry	91.91	107.16	78.49	123.97	87.82	54.15	543.50
Service activties	87.60	131.45	102.31	296.73	77.07	44.00	739.17
Total	210.00	290.00	295.00	495.00	185.00	125.00	1600.00
Value added	90.00	210.00	405.00				705.00
Output	300.00	500.00	700.00				1500.00
Imports of similar products	17.34	43.50	39.17				100.00
Supply	317.34	543.50	739.17				1600.00

1.4 Requirements of the ESA 1995 for the input-output framework data

The ESA 1995 specifies a lot of conceptual requirements for the structure and layout of supply and use tables, symmetric input-output tables and tables linking supply and use tables to the sector accounts. These requirements refer to definitions of transactions and to concepts of classification and valuation. All these requirements will be discussed in detail in the appropriate chapters of this manual. However, a broad overview of these aspects is summarised here.

As explained in this chapter, the input-output framework according to the ESA 1995 consists of three types of data sets:

- Supply tables **(Box 1.6)**
- Use tables with separate use tables for domestic output and imports (also Box 1.6)
- Symmetric input-output tables with separate input-output tables for domestic output and imports **(Box 1.7)**

Box 1.6: Main features of the ESA 1995 supply and use tables

Classifications

Supply table

Industries: NACE
Products: CPA
Domestic output and imports. Market output, output for own final use and other non-market output is only shown for the total output by industry, the distinction is not required for each product group. Distinction between market producers and producers for own final use on the one hand and other non-market producers should only be used by industry when both types of producers are present within one industry.

Intermediate use table

Industries: NACE
Products: CPA

Final uses

Final consumption expenditure: by households, by NPISH, by government
Gross capital formation: gross fixed capital formation and valuables, changes in inventories
Exports

Value added

Compensation of employees, other net taxes on production, consumption of fixed capital, operating surplus, net

Valuation

Supply table

Basic prices including a transformation to purchasers' prices

Use table

Purchasers' prices

Statistical units

Local kind-of-activity-units

Supplementary information by industry for use table

Fixed capital formation
Fixed capital stock
Labour inputs (persons)

Supply and use tables form the core of the system and the basis for the others. The main features of the three symmetric tables are listed in the following box. It should be noted that not all features, variables and details of the supply and use framework are currently required in the compulsory data transmission programme of the ESA regulation.

Concerning the supply and use tables, the ESA 1995 requires the application of the European activity and product classifications: NACE and CPA. The current data transmission programme of the ESA Regulation requires the application of the main classifications with 60 industries and 60 products.

At present, the European supply and use tables are square tables with the same number of products and industries. Rectangular tables are not required at the European level. However, as explained in chapter 2, rectangular tables have specific advantages. At best, they reflect specific national structures. Supplementary information linked to industries is a worthwhile element, such as information on gross fixed capital formation, capital stock and labour input.

Box 1.7: Main features of the ESA 1995 symmetric input-output tables

Kind of table

Product by product input-output table
Industry by industry input-output table

Transformation method

Product technology assumption
Fixed product sales structure assumption

Classifications

Products: CPA
Industries NACE

Valuation

Basic prices

Domestic output and Imports

Product by product input-output tables for domestic output and for imports
Industry by industry input-output tables for domestic output and for imports

The new valuation method of the national accounts system is valuation at basic prices. This is the most homogeneous valuation basis achievable in a statistical accounting framework. For the deflation of gross domestic product on the basis of a supply and use system and the compilation of input-output tables from supply and use tables, a transformation of the use table at purchasers' prices to a use table at basic prices is required.

Regarding the underlying statistical units, the ESA 1995 recommends the use of local kind-of-activity units, as this type of unit is best suited for the analysis of technical and economic relationships. In consequence, institutional units must be partitioned into smaller and more homogeneous units with regard to the kind of production. Local kind-of-activity units are intended to meet this requirement as the best practice-oriented operational approach.

The ESA 1995 does not explicitly deal with tables for geographical areas. It is clear that for such regional tables additional data are required to distinguish between imports and exports from EU countries and non-EU countries. In the case of multi-regional tables, the whole interdependencies between regions need to be explored. On the other hand, the concepts and definitions of the ESA 1995 are also valid for regional and multi-regional tables.

The supply and use system of ESA 1995 offers a flexible approach to compile industry by industry input-output tables or product by product input-output tables according to the objective of economic analysis. As in SNA 1993, it is recommended to compile product by product input-output tables. However, industry by industry input-output tables are also accepted if the industries are close to homogeneous units of production.

The transmission programme of the ESA 1995 requests regular data provision on all three data sets of the input-output framework:

- Annual supply table at basic prices, including a transformation into purchasers' prices, both at current and constant prices,
- Annual use table at purchasers' prices, both at current and in constant prices,
- Five-yearly symmetric input-output tables, including separate input-output tables for both domestic output and imports, at current prices.
- The supply and use tables and the symmetric input-output tables have to be provided by each country of the European Union within a maximum delay of T + 36 months.

It can be stated that supply and use tables are an integral part of the ESA 1995. The supply and use system is not only an important conceptual feature of the national accounts but also the best framework to compile reliable and consistent national accounts data.

Compilation principles and methods

chapter 2

2.1 Introduction

The ESA framework consists of three main sets of tables:

- the accounts by institutional sector,
- the tables by industry and
- the input-output framework.

The sector accounts provide a systematic description of the different stages of the economic process by institutional sector: production, generation of income, distribution of income, redistribution of income, use of income, and financial and non-financial accumulation. The tables by industry contain information on output, intermediate consumption and the components of gross value added for each industry. The supply and use tables and symmetric input-output tables of the input-output framework describe in more detail the production process (cost structure, income generated and employment) and the flows of goods and services (output, imports, exports, final consumption, intermediate consumption and capital formation) by product group. These tables reflect the growing interdependency in production.

The compilation of the input-output framework dataset of the ESA 1995 is a complex process depending on the full integration of the current accounts and accumulation accounts. As explained in Chapter 1 the input-output framework consists of three types of tables: supply tables, use tables and symmetric input-output tables. The three types of tables are interrelated, as supply and use tables form the basis for the compilation of symmetric input-output tables. The input-output framework must fully comply with all other accounts of the national accounts system, namely with the production account and the distribution and use of income accounts. The balancing of the supply and use system will ensure the consistency between the various parts of the national accounting system.

Therefore, the compilation of the input-output framework dataset cannot be seen as being independent from the compilation of the other accounts of the system. However, for reasons of simplicity these relationships will not be discussed in detail in the following description of the main compilation steps of the input-output framework. The specific role of supply and use tables in national accounts is discussed in **Chapter 3** (Supply and use tables as an integral part of the compilation of national accounts) of this manual.

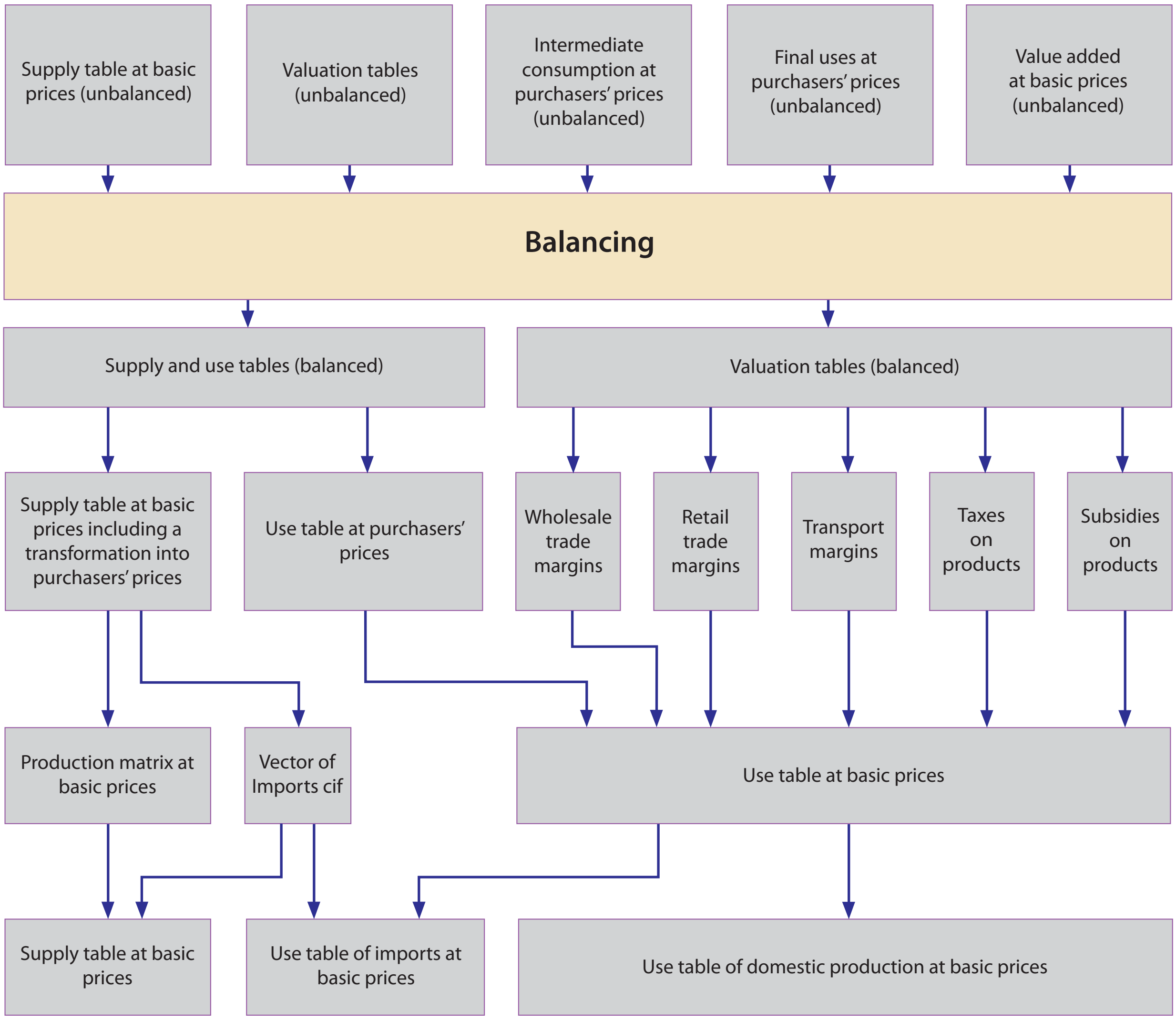
The first step in compiling supply and use tables is to compile separate tables for supply, valuation, intermediate uses and final uses (Figure 2.1). The *first principal table* is the supply table at basic prices (unbalanced). It consists of two sub-matrices: the table of domestic output and the table of imports. The *next principal tables* are the valuation tables (unbalanced). The valuation tables comprise information on taxes less subsidies on products, trade margins and transport margins. These valuation tables allow the transformation of total supply at basic prices into total supply at purchasers' prices.

Clearly, each sub-matrix of the supply table needs several compilation steps in itself. So, for example, the output table might have to be compiled from different data sources for the different activities. Such data may also have varying quality, detail and coverage. The same applies to the compilation of the supply of imports. Here foreign trade statistics can be used for goods and balance of payments statistics for services. In many cases the data has to be elaborated further and product subdivisions have to be estimated. For the estimates on direct imports from abroad other data sources may have to be exploited.

The *third principal table* is the table on intermediate consumption at purchasers' prices (unbalanced), showing the input requirements of goods and services for the production of the outputs of each industry. Once again, the compilation will consist of several steps estimating the input structure according to data sources and the typical cost structure of industries. The data in the use table of intermediate consumption are valued at purchasers' prices as this valuation is usually given in the data sources on inputs.

The *fourth basic table* is the table on final uses at purchasers' prices (unbalanced). The categories of final uses are final consumption expenditure by households, final consumption expenditure by non-profit institutions serving households (NPISH), final consumption expenditure by government, gross fixed capital formation, changes in valuables, changes in inventories and exports of goods and services. It is evident that for each category of final use, separate compilation steps are needed. The table on final uses is based on data sources valued at purchasers prices, i.e. at the prices that have to be paid by the purchasers of the goods and services. For example, data on private household consumption from sources such as household expenditure surveys or data on gross fixed capital formation from business surveys are valued at purchasers' prices. The value added tax (VAT) is a specific issue which may be included or not included in the data sources. In general it should be deducted as the value added tax is shown on a net basis in the system.

Figure 2.1: Overview of the compilation procedure of supply and use tables



The *fifth basic table* refers to value added at basic prices (unbalanced). Here the components of value added are shown by industry. The components of value added contain information on compensation of employees, other net taxes on production, consumption of fixed capital and net operating surplus.

These five basic tables may not necessarily be compiled in the same order as shown in **Box 2.1.** In fact, there is also a significant amount of interdependency in the compilation process of these basic tables. For example, margins and net taxes on products are necessary for the transformation of the supply data from purchasers' prices at basic prices. However, this information is also required to balance the supply and use tables at purchasers' prices. This information may partly be gained from estimates based on the use tables. On the other hand, estimates of certain final uses require basic supply side information if the commodity flow method is applied. Nevertheless, even if there are certain interdependencies in the compilation of these tables, it is vital that these tables are viewed and accepted as primary estimates. At this step of the compilation procedure these tables are not yet balanced. Thus neither the identity for each product is given that supply equals use nor is the identity valid for each industry that input equals output.

In Box 2.1 the main features of the compilation procedure of supply and use tables are presented. Starting point of the compilation process are four unbalanced supply and use tables. The balancing procedure is an iterative procedure integrating:

- balancing of supply and use tables at purchasers' prices,
- compilation of valuation matrices
- transformation of supply and use tables into basic prices,
- compilation of separate use tables for use of domestic output and use of imports,
- balancing of supply and use tables at purchasers' prices and at basic prices, and
- final balancing in both current and constant prices (preferably at previous years' prices).

In Box 2.2 a small numerical example is given for the compilation of balanced supply and use tables. For the supply and use tables at purchasers' prices two identities hold: total supply of products at purchasers' prices (supply table) equals total uses of products at purchasers' prices (use tables) and total output of industries at basic prices (supply table) equals total input of industries at basic prices (use table). For the supply and use tables at basic prices the identities are: total supply of products at basic prices equals total uses of products at basic prices and total output of industries at basic prices equals total input of industries at basic prices. It should be noted that the grand totals of the valuation matrices by product are shifted as column vectors to the supply table at basic prices including a transformation to purchasers' prices.

The detailed conceptual and compilation aspects of the basic tables are described in **Chapter 4** (The supply table) and **Chapter 5** (The use table) of this manual.

Four starting tables are reported at the top of Box 2.1. This box tries to give a simplified overview of the compilation process of the supply and use tables. The compilation of these four tables allows balancing supply and use and input and output.

Balancing is not just necessary in order to achieve identity between supply and use for each product, and identity between output and input for each industry. Balancing also allows us to trace inconsistencies of basic data and estimation methods. Ideally, the balancing of the supply and use system is done both at current prices and constant prices simultaneously.

In fact, balancing is not complete until the transformation into basic prices and the separation of the use of domestically produced products from the use of imported products has been achieved. It is demonstrated in Box 2.1 that these steps have to be performed after balancing supply and use. However, it should be noted that these steps are in practice interrelated. It is thus recommended to balance simultaneously supply and use at purchasers' and basic prices and also simultaneously for domestic and imported products.

Before doing so, however, the various valuation matrices for product taxes, product subsidies, trade margins and transport margins need to be estimated. The compilation of these valuation matrices is described in **Chapter 6** (Valuation matrices) of this manual. In addition, the use table of imports must be compiled. This is explained in **Chapter 7** (Import matrices). The balancing procedures are explained in **Chapter 8** (Balancing of supply and use) of this manual.

It is outlined in Table 2.1 how the various valuation matrices are deducted from the use table at purchasers' prices. Deducting product taxes less subsidies, trade margins and transport margins from the data at purchasers' prices will result in supply and use data at basic prices.

However, the trade and transport margins need not only be deducted from each transaction in the use tables, but the deducted margins need to be reallocated to the relevant trade and transport services. In consequence, the totals in the last row of the trade margins table and the transport margins table are zero. Insofar, the margins tables provide only a different allocation of trade and transport margins with positive and negative entries in each column of the table. This is demonstrated for a numerical example in Box 2.2.

In a similar way the use matrix of imports is deducted from the estimated use table. This is shown in Box 2.1 and Box 2.2. However, this step means only a separation between use flows from domestic and import origin, no reallocations are necessary here. The final result of the compilation steps is a balanced system of supply and use tables at basic prices with a separation of the use of domestically produced goods and services and the use of imported goods and services.

Box 2.1: Compilation procedure of supply and use tables

UNBALANCED SUPPLY AND USE SYSTEM

Supply table at basic prices including a transformation into purchasers' prices

	Industries	Total domestic supply	Imports cif	Total supply basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply purchasers' prices
Products	Output by product at basic prices	Domestic output	Imports	Supply basic prices	Margins	Taxes	Supply purch. p.
Total	Output at basic prices						

Intermediate consumption at purchasers' prices

	Industries	Total
Products	Intermediate consumption at purchasers' prices	
Total		

Final uses at purchasers' prices

		Total
Products	Fnal uses at purchasers' prices	
Total		

Value added at basic prices

	Industries	Total
Components	Value added at basic prices	
Total		

BALANCING SUPPLY AND USE SYSTEM

Supply table at basic prices including a transformation into purchasers' prices

	Industries	Total domestic supply	Imports cif	Total supply basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply purchasers' prices
Products	Output by product at basic prices	Domestic output	Imports	Supply basic prices	Margins	Taxes	Supply purch. p.
Total	Output at basic prices						

Use table at purchasers' prices

	Industries	Categories of final uses	Total uses at purchasers' prices
Products	Intermediate consumption at purchasers' prices	Final use at purchasers' prices	Use at purch. prices
Components	Value added at basic prices		Value added
Total	Output at basic prices	Final uses pur.p.	

COMPILATION OF VALUATION TABLES

Valuation table of trade and transport margins

	Industries	Final uses	Total
Products	Trade and transport margins intermediate consumption	Trade and transport margins final uses	
Total			

Valuation table of net taxes on products

	Industries	Final uses	Total
Products	Taxes less subsidies on products for intermediate consumption	Taxes less subsidies on products for final uses	
Total			

TRANSFORMATION OF SUPPLY AND USE TABLES INTO BASIC PRICES

Supply table at basic prices

	Industries	Total domestic supply	Imports	Total supply basic prices
Products	Output by product at basic prices	Domestic output basic p.	Imports	Supply basic prices
Total	Output at basic prices			

Use table at basic prices

	Industries	Categories of final uses	Total uses at basic prices
Products	Intermediate consumption at basic prices	Final use at basic prices	Use at basic prices
	Net taxes on prod.	Net taxes on prod.	
Components	Value added at basic prices		Value added
Total	Output at basic prices	Final uses pur.p.	

COMPILATION OF SEPARATE USE TABLES FOR DOMESTIC OUTPUT AND IMPORTS

Output table at basic prices

	Industries	Total
Products	Output by product at basic prices	Domestic output basic p.
Total	Output at basic prices	

Use table of domestic output at basic prices

	Industries	Final uses	Total
Products	Domestic products for intermediate consumption at basic prices	Domestic products for final uses at basic prices	Use at basic prices
	Imported intermed.	Imported final uses	
	Net taxes on prod.	Net taxes on prod.	
Components	Value added at basic prices		Value added
Total	Output at basic prices	Final uses pur.p.	

Use table of imports at basic prices

	Industries	Final uses	Total
Products	Imported products for intermediate consumption	Imported products for final uses	Use at basic prices
Total	Intermediate uses	Final uses	

Legend

= Data

= Subtotal, total

Box 2.2: Compilation of supply and use tables – a numerical example

BALANCED SUPPLY AND USE SYSTEM

Supply table at basic prices including a transformation into purchasers' prices

		Industries			Total output at basic prices	Imports CIF	Total supply basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply at purchasers' prices
		Agriculture	Industry	Services						
Products	Agriculture	270	30	50	350	20	370	70	20	460
	Industry	10	430	100	540	50	590	105	25	720
	Services	20	40	550	610	30	640	-175	35	500
Total		300	500	700	1500	100	1600	0	80	1680

Use table at purchasers' prices

		Industries			Categories of final uses			Total uses at purchasers' prices
		Agriculture	Industry	Services	Final consumption	Gross fixed capital formation	Exports	
Products	Agriculture	41	70	177	108	26	38	460
	Industry	117	136	122	161	112	72	720
	Services	56	89	8	278	53	16	500
Value added basic prices		86	205	393	0	0	0	684
Total		300	500	700	547	191	126	

COMPILATION OF VALUATION TABLES

Valuation table of trade and transport margins

		Industries			Final uses			Total
Products	Agriculture	6	10	28	16	4	6	70
	Industry	9	15	42	24	6	9	105
	Services	-15	-25	-70	-40	-10	-15	-175
Total		0	0	0	0	0	0	0

Valuation table of net taxes on products

		Industries			Final uses			Total
Products	Agriculture	1	1	6	11	1	0	20
	Industry	2	2	3	14	3	1	25
	Services	1	2	3	27	2	0	35
Total		4	5	12	52	6	1	80

TRANSFORMATION OF SUPPLY AND USE TABLES TO BASIC PRICES

Supply table at basic prices

		Industries			Total output at basic prices	Imports CIF	Total supply at basic prices
		Agriculture	Industry	Services			
Products	Agriculture	270	30	50	350	20	370
	Industry	10	430	100	540	50	590
	Services	20	40	550	610	30	640
Total		300	500	700	1500	100	1600

Use table at basic prices

		Industries			Categories of final uses			Total uses at basic prices
		Agriculture	Industry	Services	Final consumption	Gross fixed capital formation	Exports	
Pro ducts	Agriculture	34	59	143	81	21	32	370
	Industry	106	119	77	123	103	62	590
	Services	70	112	75	291	61	31	640
Net taxes on products		4	5	12	52	6	1	80
Value added basic prices		86	205	393	0	0	0	684
Total		300	500	700	547	191	126	

COMPILATION OF SEPARATE USE TABLES FOR DOMESTIC OUTPUT AND IMPORTS

Output table at basic prices

		Industries: Agriculture	Industries: Industry	Industries: Services	Total output at basic prices
Products	Agriculture	270	30	50	350
	Industry	10	430	100	540
	Services	20	40	550	610
Total		300	500	700	1500

Use table of domestic output at basic prices

		Industries: Agriculture	Industries: Industry	Industries: Services	Categories of final uses: Final consumption	Categories of final uses: Gross fixed capital formation	Categories of final uses: Exports	Total uses at basic prices
Products	Agriculture	30	50	140	80	20	30	350
	Industry	90	100	70	120	100	60	540
	Services	60	100	70	290	60	30	610
Imports		30	40	15	5	5	5	100
Net taxes on products		4	5	12	52	6	1	80
Value added basic prices		86	205	393	0	0	0	684
Total		300	500	700	547	191	126	

Use table of imports at basic prices

		Industries			Final uses			Total
Products	Agriculture	4	9	3	1	1	2	20
	Industry	16	19	7	3	3	2	50
	Services	10	12	5	1	1	1	30
Total		30	40	15	5	5	5	100

Legend

= Data

= Subtotal, total

For reasons of simplicity, Box 2.1 does not show any supplementary data, such as labour and capital inputs by industry, or any other subdivisions of the supply and use tables, such as a differentiation between market output, output for own final use and other non-market output. Also the compilation of supply and use tables at constant prices is not explicitly shown in this box. The compilation of constant price tables can start after the supply and use tables have been compiled at current prices. In **Chapter 9** (Supply and use tables at constant prices) it is recommended to compile supply and use tables at current and constant prices in a simultaneous procedure.

The third part of the input-output framework, the tables linking to the sector accounts, involves statistical work. Data by industry need to be subdivided according to the institutional sectors to which the units within each industry are classified. The compilation of these tables is described in **Chapter 10** (Tables linking the supply and use tables to he sector accounts) of the Manual.

Table 2.1: Transforming the use data from purchasers' prices to basic prices

Products \ Industries	Industries			Final uses			Uses
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Use table at purchasers' prices							
Agricultural products Industrial products Services	Intermediate consumption at purchasers' prices			Final uses at purchasers' prices			Total uses at purchasers' prices
Value added	Value added at basic prices						Total
Output	Output at basic prices			Total final uses at purchasers' prices			
Minus trade margins							
Agricultural products Industrial products Services	Trade margins of intermediate consumption			Trade margins of final uses			Total
Total	Zero			Zero			
Minus transport margins							
Agricultural products Industrial products Services	Transport margins of intermediate consumption			Transport margins of final uses			Total
Total	Zero			Zero			
Minus taxes on products plus subsidies on products							
Agricultural products Industrial products Services	Taxes less subsidies on intermediate consumption			Taxes less subsidies on final uses			Total
Total	Total			Total			
Equals use table at basic prices							
Agricultural products Industrial products Services	Intermediate consumption at basic prices			Final uses at basic prices			Total uses at basic prices
Net taxes on products	Net taxes on products			Net taxes on products			Total
Value added	Value added at basic prices						Total
Output	Output at basic prices			Total final uses at purchasers' prices			

The compilation of symmetric input-output tables is quite different in nature from the compilation of the supply and use tables. This process should better be described as an analytical step or transformation rather than compilation. It can be viewed as a step from statistics to modelling. The transformation procedure is explained in **Chapter 11** (Transformation of supply and use tables to symmetric input-output tables) of the Manual.

2.2 Layout of national input-output framework

One of the basic aspects before starting to compile the tables of the input-output framework is to set out the layout of the tables in terms of classifications and levels of detail. The level of detail is usually much greater for the working version than for the version that will be published. Of course, also the level of detail of the national supply and use tables might be much greater than the level of detail that is to be reported to Eurostat on the basis of the compulsory data delivery programme as described in the introduction.

Classification

Activity and product classifications are fixed. The application of the General Industrial Classification of Industries within the European Communities (NACE) and Central Product Classification (CPA) both for Community and for national statistics is laid down in respective Council Regulations. For the classifications of the industries, NACE or the derived national version has to be used. Similarly for the classification of the products CPA or the derived national version has to be implemented. This also holds true for the Classifications of individual consumption by purpose (COICOP), the Classification of the functions of the government (COFOG) and the Classification of the purposes of non-profit institutions serving households (COPNI). These classifications are part of the ESA Regulation but not directly part of the supply and use system. However, it will be explained in **Chapter 12** (Supplementary information and disaggregation of expenditure) how these features can be integrated. Other types of classifications for various macroeconomic variables, such as different types of capital formation, also have to be observed.

Level of details

The choice is therefore not which classifications should be used in the national input-output framework, but only at which level of detail the supply and use system is established. Concerning industries, the working level will primarily have to consider the user needs and the availability of data, as well as the level of detail used in national accounts. Furthermore, certain compilation aspects will also influence the working level, such as the distinction between industries which are allowed to deduct VAT and those that are not allowed to deduct VAT, the distinction between market and non-market activities and the subdivisions according to institutional sectors. Similarly, certain industry subdivisions might be relevant for the compilation of the trade and transport margin matrices.

The following elements will have a significant impact on the level of available details:

- homogeneity of price indices and values for deflation,
- matching VAT rates to products,
- availability of source data,
- quality of source data,
- benchmarking (annual as opposed to 5-yearly),
- staff resources, time schedules for production and publication and
- system infrastructure.

Rectangular supply and use system

Concerning the level of products a principle decision has to be made whether to compile a square or a rectangular supply and use system. In a square system the number of products equals the number of industries. In a rectangular system the number of products can be quite higher than the number of industries, thus showing for each industry not only one primary product. Some Member States compile rectangular systems with 2000 to 3000 products and 100 to 200 industries.

Rectangular tables do not only provide a much more detailed picture of the supply and use of goods and services in an economy. A higher degree of product detail supports also the use of certain estimation methods, such as the commodity flow method of compiling national accounts by taking into account the relevant differentiation concerning product tax rates, margin rates and homogeneity in prices. Moreover, it is much easier to distribute disaggregated homogenous products and services across industries and final demand categories with the commodity flow method than at a higher aggregate level. Detailed product accounts also help in the balancing procedure, as it is easier to explore and detect the causes of imbalances if the basis is determined by homogeneous single products rather than aggregate groups of products. The work on a detailed product level will certainly increase the data quality. At higher levels of aggregation, problems of imbalances might not even be seen at all and therefore not be dealt with.

Consequently, it is advisable to work at a level of product data with as much detail as possible. However, it is also clear that for the compilation of rectangular tables more detailed and comprehensive basic data are needed. Experience shows that the compilation of rectangular tables does not involve higher workloads after the system has been set up.

Functional classification

Questions of table layout also arise for the final use part of the system. It could be worthwhile to integrate the functional classifications in the final consumption data, showing final consumption by products and by consumption purpose. This would also be an important step in the integration of compiling supply and use data and the other accounts of the system.

Supplementary information

Another aspect relates to gross fixed capital formation. There is not only the option to introduce different categories of fixed capital formation into the system but also to integrate an investment matrix cross-classifying the producing industry of capital goods and the investing industries. The investment matrix will establish the basis for compiling capital stock data from cumulative net investment of the past by applying the perpetual inventory method. From a compilation point of view, one further aspect is again the distinction between investing industries which are entitled or not entitled to deduct VAT from their investment purchases.

Changes in inventories

With respect to changes in inventories, a distinction between output stocks, input stocks and trading stocks is useful for estimating the product structure, as well as for the allocation of imports and margins.

Intra EU and extra EU foreign trade

Concerning imports and exports of goods and services, a geographical breakdown, such as intra EU and extra EU exports and imports, is highly useful. Another subdivision may refer to specific goods and services.

National accounts

However, it is not just the data structure of the supply and use system that needs to be determined. Further basic features need attention. One important aspect refers to the relationship between national accounts compilation and compilation of the supply and use tables. As explained in Chapter 1 it is the aim of the ESA 1995 that the compilation of national accounts should be based on the supply and use framework as supply and use tables play an important role in ensuring the consistency and overall quality of the national accounts. However, this can only be achieved if the supply and use tables are compiled as a fully integrated part of national accounts calculation. This target is certainly a huge challenge, especially for countries with a loose connection between datasets and their actual compilation, or for countries where supply and use tables are calculated after the compilation of the national accounts is completed. However, with a view to the overall goal of reliable estimates of national accounts data, every effort should be undertaken to achieve an integrated compilation system for macroeconomic data. These specific aspects are discussed in Chapter 3 (The role of supply and use tables as an integral part of the compilation of national accounts).

The compilation methods should meet all requirements of the ESA 1995 standards as well as the requirements for the Council Regulation on the harmonisation of gross national income at market prices (GNI Regulation) and for the Handbook on price and volume measures in national accounts.

Data processing

Obviously, the tools of electronic data processing are important features of the compilation system. Quite a lot of detailed and diverse data need to be handled, different data sources have to be explored and various estimation procedures need to be applied. All these features support the balancing and publication of the supply and use data with acceptable time lags.

Confidentiality

A final aspect which needs attention refers to the problem of confidentiality. Countries may apply different criteria to decide whether specific data may be disclosed or not. Usually, the number of enterprises observed in an industry takes influence on this decision. One solution would be to choose a higher aggregation level with a sufficient number of enterprises in an industry. There might not always be an easy solution to which industry or product a confidential industry should be allocated. The price is a loss of information due to aggregation resulting in a larger heterogeneity of the supply and use system. Other methods might therefore also be explored or combined, such as creating or redefining products.

2.3 Compilation methods

In addition to the general compilation methods and the sequence of compilation steps, specific estimation methods are needed. All compilation concepts and methods that are used in national accounting are also required for the compilation of supply and use tables. Examples of such methods are the commodity flow method or the double deflation method. Specific methodologies are required for supply and use tables, such as the methods to compile the valuation matrices and the import matrices, or the transformation methods of supply and use tables into symmetric input-output tables. The aim should be to collect as much coherent and consistent business data using surveys sampled from a high quality business register as possible. All these methods are described in the relevant chapters of this manual.

However, further methodologies and estimation methods have to be considered in order to be able to estimate elements of the supply and use system on the basis of weak, insufficient or missing data. This is based on the fact that the data available are usually insufficient and not comprehensive enough or that certain data cannot be collected at all. An example of data that cannot be collected in most cases is the share of imported products in the use data.

Missing data

If certain data are not available in the official statistics system, the first idea would be to check whether similar data are available outside official statistics. An example is, for instance, when intermediate data on advertising costs are not available as a separate item in the business surveys. Here, one could probably base the estimates on data from private marketing or research companies observing the advertising market. Although the data are often not comprehensive enough, or the classifications used differ from the official ones, or any other aspect applies so that that data does not fully conform to the required concepts, these data certainly give a good indication of the advertising market over the various industries.

Similar private databases may be available for certain other markets, such as for the computer market, but only covering information on physical data rather than monetary data. Data on the number of private households connected to the internet may serve as a basis for an estimate of the payments by private households for internet provider fees. Usually, there is a great deal of data on various product markets provided by private marketing firms or research institutes. Even in cases where such information cannot be used directly, these data may serve as proxies, indirect indicators or for checking certain estimates.

Furthermore, if no specific data are available, these institutes could provide valuable expert advice. Similarly, chambers of commerce, trade associations, research institutes or other similar organisations could also provide useful and important expertise.

In certain industries, one or a few companies are the big players in that market. They could also be contacted for expertise or providing some of their internal data. For example, telecommunication companies may provide their revenue data by branches of their customers, supermarket chains may be asked to provide data on their sales by products, major railway companies to provide data on the goods transported, and so on.

While in the above cases additional data would be helpful for the compilation, for certain industries it is essential that the big or dominating companies provide some specific data for supply and use purposes. An example could be the airline market. In this case it is important to ask the company for certain additional information concerning the cost structure. Without such additional information it would be quite difficult to correctly estimate the costs of fuel bought abroad by the airline industry, or the costs of catering, to name two examples. Other industries where additional information might be quite advisable are the railway industry, the telecommunication industry and the radio and television industry. Generally, the need for additional data might be much greater for the service industries than for the manufacturing industries which are still more comprehensively covered in official statistics.

Annual company reports and accounts, publications of regulatory bodies and trade associations, and internet company web-sites are very useful sources of financial data for businesses and households.

Coherence of the supply and use system

Certain estimates can be based on the identities and coherence of the supply and use framework. This holds true for the application of the commodity flow method, where detailed supply data are used to estimate certain use data. This may not always be possible, however the supply and use framework is still of help. An example might be the estimate of veterinary services supplied to private households. A good estimate based on supply can only be made if there is reliable information on the use of veterinary services in agriculture, which is the predominant user of such services. Other users, such as the food industry, then still remain to be taken into account. From the supply side alone an estimate determined by deducting the uses in agriculture and other industries from total supply seems to be one option. However, it would be preferable to check the resulting data with another independent source.

Another, more complex, example might be the product of airport fees. There is, however, usually only one industry producing airport services and there is one main industry consuming airport services. However, airport services can be imported and exported, which in the case of veterinary services could more or less be ignored. If we know, for example, domestic output, imports and exports we can calculate domestic use or any of the four variables if the three others are known. In this case we can easily calculate the import share of the use as the imports of airport services can be attributed to the airline industry. However, in case we only know two of the four variables we would need at least an indication of one of the missing data. Furthermore, in this example we should also not forget other users of airport services such as private households owning smaller airplanes for private purposes and companies possessing their own airplanes. Of course, information on airport fee costs in these sectors might not be known and could be neglected because of their small volume. We also have to consider that there are two types of airport fees, one for the aircraft machines (to be paid by the airline companies and the other owner of aircraft) and one for passengers, usually to be paid together with the plane ticket. So, the second type is to be allocated with the use of air traffic services. Again, imports and exports – related to tourism – need to be considered.

The Commodity flow method basically applies fixed allocations which will need to be reviewed each year The method should be applied with great caution to populate supply and use tables. The collection of primary data from various sources with data confrontation provides the best approach to populate the tables and to achieve quality results.

Consequences

These examples should illustrate three aspects: firstly, that due to the coherence of the accounting framework, it is possible to calculate data indirectly by using the identities of supply and use; secondly, that it is often quite important to work on a detailed product classification level in order to correctly allocate supply or use flows. Thirdly, however, we would prefer to be armed with specific additional information of exogenous or independent character to improve the estimates or at least to be able to perform cross-checks. If we only used supply data for estimating the use figures we would not be able to evaluate basic data and check their consistency.

Nevertheless, we should be aware that in practice we are often forced to use such estimation methods based on the accounting identities. Compilers should also be used for making estimates on the basis of physical data and on the basis of incomplete data, using indirect indicators, and making guesses and assumptions. For all these situations, expertise and experience are a great help and innovations in dealing with such situations might be needed daily. The quality and plausibility of the estimates will have to be proven at the balancing stage.

Compiling supply and use tables for the first time or on a new conceptual basis is clearly much more laborious and time consuming than making estimates for just another year. In the latter case, the data and structure from the previous year can give valuable help. Structures from the previous year might even serve as a first estimate. Of course, all information available for the current year should be taken into account. Quite often, some totals for the current year data are available but not the product details. If structures from the previous year are used, one has to bear in mind that structure clearly changes over time. For example the share of the products in intermediate consumption change because of technological changes, because of changes in the output mix of the industries, because of changes in the relative prices of the products, because of changes in the institutional settings, and so on. Nevertheless, on a year to year basis such changes would normally not be dramatic so this method could certainly be of great help in speeding up the compilation process and making the work less time-consuming. However, it should be emphasised that the balancing of the system would then deserve more attention.

Documentation

As the compilation of supply and use data is a complex process, a thorough documentation of the basic data and the methods used, the problems encountered and the results achieved is highly recommended. Such an inventory is not only worthwhile for purposes of publication but also for internal use in the compilation process itself. When supply and use table have to be balanced, in particular information on the sources and methods of estimation for each single supply and use element is needed. This will be of help when the reasons for imbalances are analysed. The documentation then helps to evaluate the quality of the data and to outline the strategy for balancing. Of course, the balancing steps should also be documented in order to avoid repeating changes and destruction of already balanced data.

Documentation of the various compilation steps will also point to missing data issues and problems of basic data quality. It is important that such findings are utilised as feedbacks to primary statistics and give pointers to improving the compilation methodology. A documentation system for the supply and use table compilation should be seen in the frame of the overall documentation system of national accounting.

Building up a supply and use system is like solving a puzzle. At first, all macroeconomic data, survey results, census results and other valid economic data on supply and demand of the economy have to be collected. In a second step, missing data has to be estimated on the basis of harmonised methodologies and documented procedures. In the third and final stage the balancing of the supply and use system is generating a consistent set of macroeconomic variables at current and constant prices. It is desirable that how the supply and use tables were generated is documented in a professional way. An essential feature is the documentation of all stages of the compilation of 'hard' data in terms of sources and 'soft' data in terms of estimates and adjustments, ideally for each cell of the supply and use system.

Links between survey data and final national accounts data should be maintained in the system, in particular for survey data, coverage adjustments, conceptual and valuation adjustments, quality adjustments and balancing and coherence adjustments.

2.4 National database

In order to compile supply and use tables many data and other sources are necessary. For the compilation of the output table, data are required that show the output of products by industries. For the compilation of the intermediate consumption table, data are essential in identifying the input requirements for intermediate consumption by products for each industry. For the final uses table, disaggregated survey results will enable the elaboration of typical input structures by product for the various categories of final uses. Furthermore, specific data are needed to compile the various valuation matrices. Last but not least, data concerning each component of value added by industries are required.

In general, the data needs for supply and use tables are in fact quite similar to those for national accounts. However, for the supply and use tables, data classified by products are of special importance. Data by products are not only necessary for showing supply and use of products as a result of the supply and use tables compilation, but also because detailed data by products permit the use of certain estimation methods, such as the commodity flow method, as explained above.

Even if there is certain harmonisation in the availability of economic statistics data in the Member States of the EU, the overall data situation may differ widely from country to country. ESA 1995 has brought a strong harmonisation in the use of the statistical classifications and – at least conceptually – a harmonisation in the definitions of the statistical units. However, harmonised economic data is still less common, except in areas where European Regulations currently force the Member States to provide such data. Such areas include foreign trade statistics, industrial production statistics, business cycle statistics and structural business statistics. These data are, of course, important for supply and use tables, but the information they provide are not sufficient. The European economic statistics do not cover all relevant activities nor always respect the required statistical units and required data for the national compilation of national accounts.

It must be concluded that the European harmonised economic statistics system is not primarily designed to provide a comprehensive database for national accounts and the supply and use tables. It is therefore up to the Member States to design their system of economic statistics in order to be able to fulfil the requirements of the ESA Regulation.

An important basic requirement for high quality economic statistics is the availability of a comprehensive and up-to-date business register, covering the various relevant statistical units. Any efforts to improve the structure and quality of the business register will have positive effects on the basic data and thus also on the quality of the supply and use tables.

A system of economic statistics has to consider a variety of aspects, such as user needs, statistical units, coverage, domains and variables, time frame, whether compulsory or voluntary, whether full coverage or sample-based and many other aspects of survey design. In addition, resources and costs as well as respondent burdens have to be taken into account. The various aspects and differing user needs may often be conflicting, so that compromise solutions will have to be achieved. It is clear that the data needs for national accounts and for the supply and use tables might be viewed as important ones, but they are certainly not the only ones and sometimes not the ones with the highest priority. On the other hand, it should be emphasised that the various economic surveys are to be designed under a systems approach so that the data can be compared to each other. In this respect, national accounts should be of guidance.

It has to be accepted that the economic statistics database of a given country will never meet all the requirements for compiling supply and use tables. However, there should be a continuous effort to improve the database and to better fulfil the needs. Countries that have compiled supply and use tables for a long time may have lesser need to expand and improve their data system than countries that are at the beginning of compiling supply and use tables and are facing crucial data shortages.

Identified data shortages can be met in different ways. One possibility could be to enlarge the already existing surveys by introducing a larger sample size and or additional variables with greater coverage. Another way could be to create new regular surveys for areas not yet covered. A third method could be to run specific surveys for supply and use purposes. A further possibility would be to meet additional data needs by accessing administrative data sources.

In general, the availability of existing data – also outside the official statistical system – should be explored before additional respondent burdens are enlarged. Further improvements would be achieved if the concepts and variables of data sources were close to concepts of national accounts.

Needless to say, the economic database greatly influences the quality of the resulting supply and use tables and therefore the national accounts. The less information is available, the more estimates and guesses have to be made. Of course, the supply and use framework supports cross-checks of estimated data, especially in the stage of balancing. However, the available database is still of crucial importance for the overall quality of the supply and use data.

Supply and use tables as an integral part of the compilation of national accounts

chapter 3

3.1 Introduction

The compilation of supply and use tables has often been associated with the construction of symmetric input-output tables. In practice supply and use tables have been seen as a necessary first step for the calculation of input-output tables. This approach has led to a practice in many countries where supply and use tables (SUT) are calculated after the compilation of the national accounts has been completed. This procedure has, in fact, created great problems because the independently calculated national accounts aggregates had to be kept unchanged despite inconsistencies in the supply and use system.

The role of supply and use tables in the compilation of national accounts should be seen from a much wider perspective than just as a first step in the construction of input-output tables. The compilation of supply and use tables provides the ideal framework guaranteeing the consistency of supply and demand in the system at current and constant prices and the overall quality of the national accounts. This main function of supply and use tables in the balancing process of national accounts is independent of the decision whether input-output tables are compiled or not. Therefore, it is recommended that supply and use tables are compiled as an integral part in the calculation of national accounts.

The recommendations for compiling SUT as an integral part in the production of national accounts can be formulated in general terms as follows:

- Supply and use tables are the most efficient way to incorporate all basic data – aggregated or detailed – into the national accounts framework in a systematic way.
- Supply and use tables effectively ensure the consistency of results at a detailed level and thereby improve the overall quality of the national accounts.
- The SUTs framework provides the natural statistical framework to include the components of the production, income and expenditure approaches to measuring GDP, thereby enabling a coherent and balanced estimate of GDP both in current prices and constant prices to be achieved.
- The balanced SUTs provide consistency and coherency between the first three accounts of the National Accounts framework: Goods and Services Account; Production Accounts by industry and sector; and Generation of Income Accounts by industry and sector.

3.2 Compilation of national accounts

Figure 3.1 demonstrates which basic sources are used to compile the national accounts. In general, a mixture of administrative records and statistical surveys is used as sources for the national accounts. The sample frame for the main surveys is determined by an Establishment Census or the Business Register. The Business Register is an important instrument of the statistical system. It comprises in principle all production units, listing names and addresses of all financial and non-financial corporations operating in the economy.

The statistical units in the Business Register form the basis for the compilation and production of economic statistics. The register comprises in principle all production units. The units are classified by activity (NACE) and size class. The units are legal units, enterprises, kind-of-activity units (KAU) and local kind-of-activity units (Local KAU).

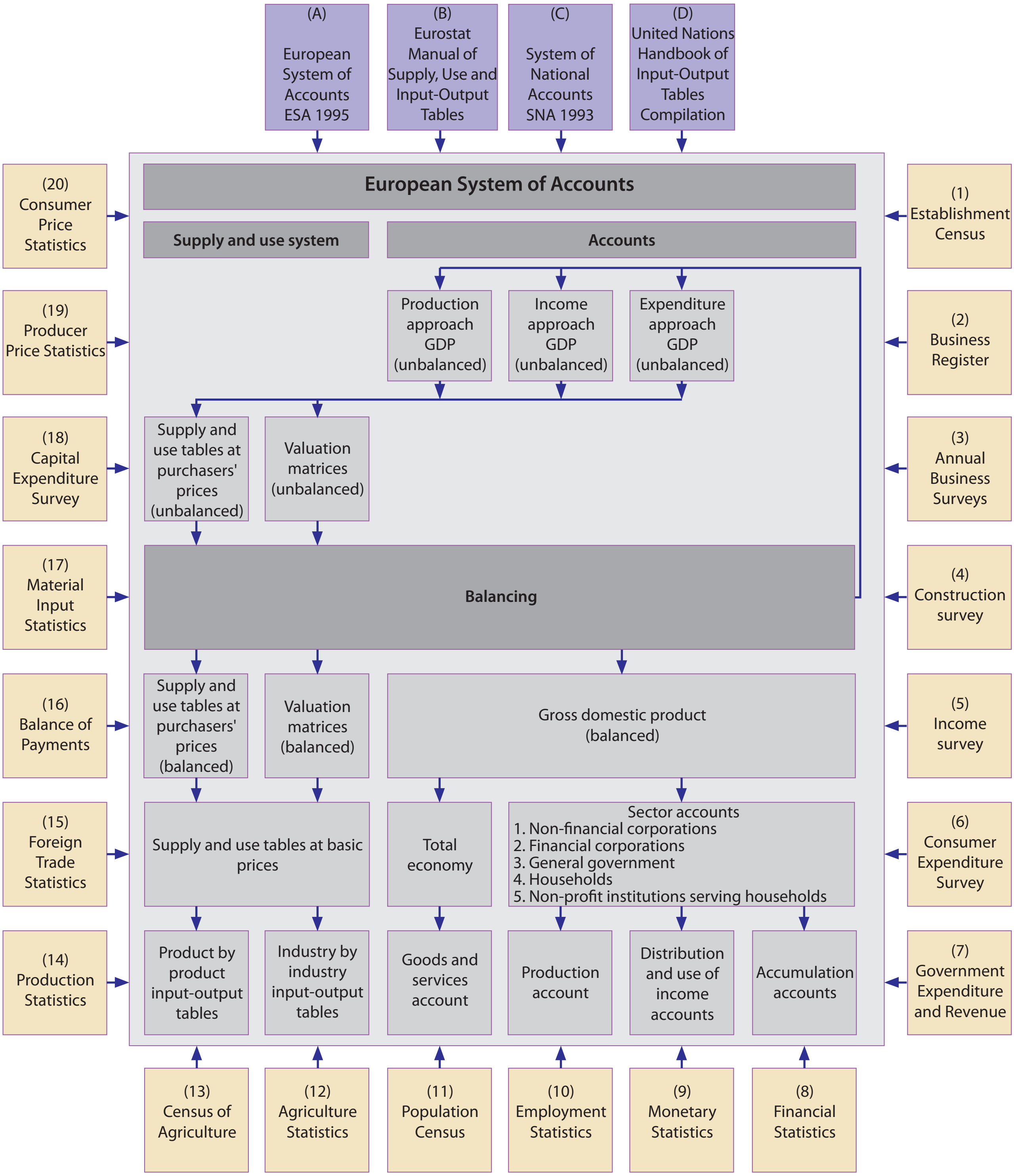
The annual estimates of gross domestic product (GDP) are obtained from the production, income and expenditure approaches and reconciled using supply and use tables. Some countries have a long tradition and much experience in utilising detailed production data based on local KAU (the establishment) as the statistical unit for compiling GDP estimates according to the production approach.

One central feature of the European System of Accounts is the balancing process of the system. Balanced macroeconomic data can be derived on a more aggregate level by applying the production, income and expenditure approaches. However, the better option is to balance the system at the same time for the sector accounts and the supply and use tables at a much deeper level of products and industries.

Production approach

The production approach is used to compute value added for all industries. This is done on an annual basis within the framework of detailed supply and use tables. The main classification schemes used are the activity classification based on NACE and the product classification based on CPA. In a rectangular supply and use system the number of activities is much smaller than the number of products.

Figure 3.1: Eurostat Manual of Supply, Use and Inut-Output Tables



In the production approach the following information on GDP is collected:

Total output at basic prices	Total output at basic prices
- Intermediate consumption at purchasers' prices	- Intermediate consumption at basic prices
= Gross value added at basic prices	= Gross domestic product
+ Taxes on products	- Taxes on products
- Subsidies on products	+ Subsidies on products
= Gross domestic product at market prices	= Gross value added at basic prices

The major sources for the production approach are annual business surveys collecting data covering sales, purchases, inventories, gross fixed capital formation, employment costs etc. The survey data are supplemented by a number of other sources, notably agricultural data and general government non-market data. The production approach looks at the contribution of each economic unit to production that is the value of their total output less the value of inputs used up in the production process.

From the point of view of production, gross domestic product at market prices is at best estimated with reference to annually compiled supply and use tables both in current prices and in prices of the previous year. Tables are compiled in previous year's prices in order to achieve an accurate breakdown of value changes in subsequent years according to volume and price changes. The base-year table provides the specific weights for each industry and product, used in the index formulae by which the price data are aggregated. The great statistical benefit of a system based on prices of the previous year is the fact that the weights in the index formulae are always up-to-date, thus reflecting the structure of the recent past.

The distinction between market and other non-market producers is important for the determinants of both output and value added. The output of market producers is determined from the revenue side. However, the output of non-market producers is calculated as the costs of all inputs including labour cost and capital consumption. In this case, the net operating surplus of non-market producers is by definition assumed to be zero. Consequently, the output value of non-market producers is equivalent to the sum of intermediate inputs, compensation of employees, other net taxes on production and consumption of fixed capital.

Three ways of valuation are applied for domestically produced goods and services, namely basic prices, producers' prices and purchasers' prices. The basic price is the amount actually realised by the producer. This amount frequently differs from the price the producer must charge in form of a producers' price, since he has also to take into account taxes on products (such as non-deductible VAT, mineral oil tax, tobacco tax and other excise duties) and subsidies on products (Box 3.1). The purchasers' price, the price paid by the customer, equals the producers' prices (net of all VAT) plus non-deductible VAT and trade and transport margins in connection with the product in question.

For imported goods two ways of valuation are of interest: namely the purchasers' price and the CIF price (cost, insurance and freight). The difference consists of taxes on products, including import duties less subsidies on products, transport margins on the domestic territory, trade margins and VAT.

In national accounts, taxes on production and taxes on products are defined in the following way:

Taxes less subsidies on products
\+ other net taxes on production
= Taxes on production and imports less subsidies.

Taxes on products include in particular value added taxes, taxes and duties on imports, and taxes on products such as stamp taxes on the sale of petrol, diesel, alcoholic beverages and tobacco. Subsidies on products include import subsidies and other subsidies on products. Other taxes on production consist of all taxes that enterprises incur as a result of engaging in production, independently of the quantity or value of the goods and services produced or sold. These may be payable on the land, fixed assets or labour employed in the production process or on certain activities or transactions. Other subsidies on production consist of subsidies which resident producer units may receive as a consequence of engaging in production including in particular subsidies on payroll or work force, subsidies to reduce pollution and grants for interest relief. Taxes and subsidies on products are not included in other net taxes on production.

In the use table, transactions are recorded at purchasers' prices. In the supply table, domestic production is recorded at basic prices and imports at CIF prices. Therefore, additional columns have to be included in the supply table in order to fill the valuation gap. The columns of the valuation matrices refer to trade margins, transport margins, taxes on products and subsidies on products. The additional columns in the supply table are derived from full size valuation matrices reflecting margins, taxes and subsidies by product for all industries and the categories of final demand.

Box 3.1: Price system of the input-output framework

Table 1: Resources
Basic prices

	Industry by industry	Agriculture	Industry	Services	Consumption	Exports	Uses
		1	2	3	4	5	6
1	Agriculture	20	40	10	60	5	135
2	Industry	20	160	40	145	100	465
3	Services	10	80	20	115	20	245
4	Taxes on domestic products	5	13	12	17	0	47
5	Subsidies on dom. products	6	4	5	0	0	15
6	Non-ded. VAT on dom. prod.	2	7	7	26	0	42
7	Taxes on imported products	1	3	2	2	0	8
8	Subsidies on imp.products	2	2	0	0	0	4
9	Non-ded. VAT on imp. prod.	1	0	3	6	0	10
10	Other net taxes on production	5	15	10	0	0	30
11	Gross value added factor cost	44	88	101	0	0	233
12	Output	100	400	200	371	125	1196
13	Imports cif similar products	35	65	45	0	0	145
14	Resources	135	465	245	371	125	1341

Table 2: Domestic production
Basic prices

	Industry by industry	Agriculture	Industry	Services	Consumption	Exports	Output
		1	2	3	4	5	6
1	Agriculture	15	25	7	50	3	100
2	Industry	10	150	15	129	96	400
3	Services	3	68	10	107	12	200
4	Imports cif	22	37	38	34	14	145
5	Taxes on domestic products	5	13	12	17	0	47
6	Subsidies on dom. products	6	4	5	0	0	15
7	Non-ded. VAT on dom. prod.	2	7	7	26	0	42
8	Taxes on imported products	1	3	2	2	0	8
9	Subsidies on imp.products	2	2	0	0	0	4
10	Non-ded. VAT on imp. prod.	1	0	3	6	0	10
11	Other net taxes on production	5	15	10	0	0	30
12	Gross value added factor cost	44	88	101	0	0	233
13	Output	100	400	200	371	125	1196

Table 3: Imports
Basic prices

	Industry by industry	Agriculture	Industry	Services	Consumption	Exports	Total
		1	2	3	4	5	6
1	Agriculture	5	15	3	10	2	35
2	Industry	10	10	25	16	4	65
3	Services	7	12	10	8	8	45
4	Total	22	37	38	34	14	145

Table 4: Resources (4 = 1 + 10 - 13)
Producers' prices (net of all VAT)

1	Agriculture	20	47	12	68	5	152
2	Industry	19	161	45	148	100	473
3	Services	9	82	22	123	20	256
4	Taxes on domestic products	16	14	17	0	0	47
5	Subsidies on dom. products	2	6	7	0	0	15
6	Non-ded. VAT on dom. prod.	2	7	7	26	0	42
7	Non-ded. VAT on imp. prod.	1	0	3	6	0	10
8	Other net taxes on production	5	15	10	0	0	30
9	Gross value added factor cost	44	88	101	0	0	233
10	Output	114	408	210	371	125	1228
11	Imports similar products cif	35	65	45	233	0	378
12	Taxes on imported products	3	3	2	0	0	8
13	Subsidies on imp.products	0	3	1	0	0	4
14	Resources	152	473	256	604	125	1610

Table 5: Domestic production (5 = 2 + 11 -14)
Producers' prices (net of all VAT)

1	Agriculture	15	31	9	56	3	114
2	Industry	10	152	18	132	96	408
3	Services	2	69	12	115	12	210
4	Imports	21	38	40	36	14	149
5	Taxes on domestic products	16	14	17	0	0	47
6	Subsidies on dom. products	2	6	7	0	0	15
7	Non-ded. VAT on dom. prod.	2	7	7	26	0	42
8	Non-ded. VAT on imp. prod.	1	0	3	6	0	10
9	Other net taxes on production	5	15	10	0	0	30
10	Gross value added factor cost	44	88	101	0	0	233
11	Output	114	408	210	371	125	1228

Table 6: Imports (6 = 3 + 12 - 15)
Producers' prices (net of all VAT)

1	Agriculture	5	16	3	12	2	38
2	Industry	9	9	27	16	4	65
3	Services	7	13	10	8	8	46
4	Total	21	38	40	36	14	149

Table 7: Resources (7 = 1 + 10 - 13 + 16)
Producers' prices (net of deductible VAT)

1	Agriculture	20	49	15	78	5	167
2	Industry	21	165	49	160	100	495
3	Services	10	83	25	133	20	271
4	Taxes on domestic products	16	14	17	0	0	47
5	Subsidies on dom.products	2	6	7	0	0	15
6	Non-ded. VAT on dom. prod.	13	15	14	0	0	42
7	Other net taxes on production	5	15	10	0	0	30
8	Gross value added factor cost	44	88	101	0	0	233
9	Output	127	423	224	371	125	1270
10	Imports similar products	35	65	45	0	0	145
11	Taxes on imported products	3	3	2	0	0	8
12	Subsidies on imp.products	0	3	1	0	0	4
13	Non-ded. VAT on imp. prod.	2	7	1	0	0	10
14	Resources	167	495	271	371	125	1429

Table 8: Domestic production (8 = 2 + 11 - 14 + 17)
Producers' prices (net of deductible VAT)

1	Agriculture	15	33	12	64	3	127
2	Industry	11	156	20	140	96	423
3	Services	3	70	14	125	12	224
4	Imports	22	38	43	42	14	159
5	Taxes on domestic products	16	14	17	0	0	47
6	Subsidies on dom.products	2	6	7	0	0	15
7	Non-ded. VAT on dom. prod.	13	15	14	0	0	42
8	Other net taxes on production	5	15	10	0	0	30
9	Gross value added factor cost	44	88	101	0	0	233
10	Output	127	423	224	371	125	1270

Table 9: Imports (9 = 3+12-15+18)
Producers' prices (net of deduct. VAT)

1	Agriculture	5	16	3	14	2	40
2	Industry	10	9	29	20	4	72
3	Services	7	13	11	8	8	47
4	Total	22	38	43	42	14	159

Table 10: Taxes on products (Resources)

1	Agriculture	1	7	3	8	0	19
2	Industry	3	4	7	3	0	17
3	Services	2	5	4	8	0	19
4	Total	6	16	14	19	0	55

Table 11: Taxes on products (Domestic production)

1	Agriculture	1	6	3	6	0	16
2	Industry	2	4	5	3	0	14
3	Services	2	3	4	8	0	17
4	Total	5	13	12	17	0	47

Table 12: Taxes on products (Imp.)

1	Agriculture	0	1	0	2	0	3
2	Industry	1	0	2	0	0	3
3	Services	0	2	0	0	0	2
4	Total	1	3	2	2	0	8

Table 13: Subsidies on products (Resources)

1	Agriculture	1	0	1	0	0	2
2	Industry	4	3	2	0	0	9
3	Services	3	3	2	0	0	8
4	Total	8	6	5	0	0	19

Table 14: Subsidies on prodcts (Domestic production)

1	Agriculture	1	0	1	0	0	2
2	Industry	2	2	2	0	0	6
3	Services	3	2	2	0	0	7
4	Total	6	4	5	0	0	15

Table 15: Subsidies (Imports)

1	Agriculture	0	0	0	0	0	0
2	Industry	2	1	0	0	0	3
3	Services	0	1	0	0	0	1
4	Total	2	2	0	0	0	4

Table 16: Non-deductible VAT (Resources)

1	Agriculture	0	2	3	10	0	15
2	Industry	2	4	4	12	0	22
3	Services	1	1	3	10	0	15
4	Total	3	7	10	32	0	52

Table 17: Non-deductible VAT (Domestic production)

1	Agriculture	0	2	3	8	0	13
2	Industry	1	4	2	8	0	15
3	Services	1	1	2	10	0	14
4	Total	2	7	7	26	0	42

Table 18: Non-deductible VAT (Imp.)

1	Agriculture	0	0	0	2	0	2
2	Industry	1	0	2	4	0	7
3	Services	0	0	1	0	0	1
4	Total	1	0	3	6	0	10

Table 19: Taxes on production and imports less subsidies

1	Net taxes on products	32	30	26	0	0	88
2	Other net taxes on production	5	15	10	0	0	30
3	Total	37	45	36	0	0	118

Table 20: Taxes on production less subsidies

1	Net taxes on products	27	23	24	0	0	74
2	Other net taxes on production	5	15	10	0	0	30
3	Total	32	38	34	0	0	104

Table 21: Net taxes on imports

1	Net taxes	5	7	2	0	0	14
2	Other net	0	0	0	0	0	0
3	Total	5	7	2	0	0	14

Income approach

The compilation of gross domestic product with reference to the income approach involves its estimation as the sum of the different components of value added, namely taxes and subsidies on products, compensation of employees, other net taxes on production and gross operating surplus. While the Production approach is by industry and by sector, the income approach is by industry, by sector and by type of income. The income approach adds up all income earned by resident individuals or corporations in the production of goods and services.

The following information on GDP is collected in the income approach:

Compensation of employees
\+ Other net taxes on production
\+ Gross operating surplus
= Gross value added at basic prices
\+ Taxes on products
\- Subsidies on products
= Gross domestic product at market prices

From the point of view of income, gross domestic product can be estimated in different ways. One can try to estimate the components of value added for the entire economy, the institutional sectors or the different industry levels. In most cases the income approach is based on a combination of these options.

Compensation of employees is estimated by industry and by sector, using business survey data, administrative data and labour accounts data, as appropriate. For the government sector and financial corporations, compensation of employees is initially estimated on the sector level and converted to the corresponding industries afterwards. For non-financial enterprises, households and NPISH, the estimates are based on the labour accounts data at industry level. Other taxes and subsidies on production are based on government information and then broken down to industries and institutional sectors.

Gross operating surplus is estimated on an industry level as residual variable (output less intermediates). However the gross operating surplus of the government and NPISH sectors includes only consumption of fixed capital. Consumption of fixed capital has to be estimated from cumulative investment of the past by applying the perpetual-inventory-method (PIM) according to the actual use of capital goods. In the household sector, mixed income of self-employed and operating surplus have to be estimated by means of the production approach by identifying production levels and costs. Some countries give a breakdown of gross operating surplus, such as profits, rentals and other types of factor incomes.

Expenditure approach

The expenditure approach is used for computing government final consumption expenditure based on government accounts and for exports and imports of goods and services based on foreign trade statistics and balance of payments statistics. The expenditure approach is also used as a main method in computing household final consumption expenditure and gross fixed capital formation.

The following information on GDP is collected in the expenditure approach:

Household final consumption expenditure
\+ NPISH final consumption expenditure
\+ Government final consumption expenditure
\+ Gross fixed capital formation
\+ Changes in inventories
\+ Acquisitions less disposals of valuables
\+ Exports of goods and services
\- Imports of goods and services
= Gross domestic product at market prices

The expenditure approach measures total expenditure on final goods and services produced in the domestic economy. It is equivalent with the sum of final uses of goods and services by resident institutional units less the value of imports of goods and services. Expenditure on gross domestic product can be estimated in the context of the supply and use tables, where independent estimates of output, intermediate consumption and final use are compared and brought into balance. The integrated procedure ensures the equality of the GDP estimates using the production approach and the expenditure approach.

The total is obtained from the sum of final consumption expenditure by households, non-profit institutions serving households (NPISH), and government on goods and services, gross fixed capital formation, and net exports of goods and services. These categories are estimated from a wide variety of sources including expenditure surveys, the internal accounting system of governments, surveys of traders and administrative documents used in importing and exporting of goods and services.

Compilation begins with the quarterly economic accounts and the production of first unbalanced estimates of GDP with its production income and expenditure components.

Final consumption expenditure by households

An important task of the expenditure approach is to estimate a matrix for final consumption expenditure by households reflecting the main consumption activities of private households. The result is a supplementary matrix with products (CPA) in the rows and the main categories of the Classification of individual consumption by purpose (COICOP) in the columns. The main data for this compilation are extracted from consumer expenditure surveys.

Final consumption expenditure of households is the most important macroeconomic variable. The majority of household consumption is accounted for by household spending on goods and services. The compilation is essentially based on consumer expenditure surveys and retail trade statistics. Household final consumption is directly linked to turnover of retail trade after allowing for sales to businesses and non-residents. Consumers buy most of their goods from retail outlets. Retail trade production statistics provide data on turnover broken down to product groups. However, consumption includes some imputed transactions like imputed rentals of owner occupied dwellings.

Final consumption expenditure by government

A second task is the compilation of a matrix for expenditure of general government by products (CPA) and by main functions of the government (COFOG). The information for final consumption expenditure by government is extracted from the government accounts. It comprises the purchase of goods and services from industries, compensation of employees, consumption of fixed capital of government institutions less government sales and revenues. For compilation, balancing and publication of results government can be split into further categories, for example central government and local government.

Gross fixed capital formation

The third task is the compilation of an investment matrix with a cross-classification of gross fixed capital formation by industry (NACE) and non-financial assets in form of buildings, machinery and transport equipment. The main source will be the Capital Expenditure Survey which is addressed to investors. More information on all three supplementary matrices is given in Chapter 12 (Supplementary information and disaggregation of expenditure).

Gross fixed capital formation is an important element in final expenditure. The relevant data are collected with reference to the purchasing industrial category and type of asset. For the supply and use tables the asset types must be broken down into product groups. Investment estimates for the various industries are largely based on specially designed surveys, collecting data on the expenditure on tangible fixed assets by type. A certain amount of processing is required before the investment data can be incorporated in the use table. Upon the completion of the industry and asset-type estimates, individual products must be linked with particular asset types. The result is a break down of gross fixed capital formation by product, by type of asset and by industry. Since the valuation of the use table is purchasers' prices excluding VAT, those industries and products that are subject to VAT are identified. The VAT is deducted so that the data in gross fixed capital formation are in the right valuation. The estimates of the investment matrix (product by industry) are then aggregated for all industries. The totals are incorporated as gross fixed capital formation in the use table.

Changes in inventories include finished goods, intermediate inputs, inventories for trade purposes and work in progress. The information is collected in business surveys or in production statistics on initial and final enterprise inventory values.

Estimates on changes of valuables are estimated in the same way as gross fixed capital formation. The estimates are mainly based on commodity flow data. Domestic output and imports constitute total supply at basic prices. Based on wholesale and retail trade data, trade and transport margins are estimated to arrive at total supply at purchasers' prices. Separate estimates for export, intermediate consumption and final consumption are made in respect to total demand.

Exports and imports of goods and services

Various sources are available for estimating exports and imports of goods and services. They include foreign trade statistics, production statistics, balance of payments statistics and other internal or external sources. Imports and exports of goods are mainly based on foreign trade statistics collecting the information on third-country trade from customs forms and intra-EU surveys on trade.

Data sources

The following list of main sources for the implementation of the production, income and expenditure approaches is not exhaustive but comprehensive. It may cover monthly, quarterly and annual sources.

Classifications

Statistical classification of economic activities in the European Community (NACE)
Statistical classification of products by activity in the European Community (CPA)
Classification of individual consumption by purpose (COICOP)
Classification of the functions of the government (COFOG)
Institutional sectors, e.g. non-financial corporations, general government, households, etc.

Registers

Business Register

Data for production approach

Agriculture statistics
Annual business surveys (manufacturing industries)
Annual business surveys covering all industries including service industries
Construction survey
Production statistics (PRODCOM)
Government and financial institutions
Annual purchases inquiry – collecting intermediate input detail as well as product margins
Service sector statistics

Data for income approach

Income statistics
Employment statistics
Government expenditure and revenues
Tax statistics
Profit surveys

Data for expenditure approach

Household survey of consumer expenditure
Budget survey
Investment survey
Foreign trade statistics
Balance of payments
Foreign trade statistics including Intrastat
International Trade in Services surveys
International Passenger Survey

Other data sources

Consumer price statistics
Producers' price statistics
Import price statistics
Export price statistics
Company annual report and accounts
Company financial web-sites
VAT paid and VAT turnover detail
Regulatory Accounts
Trade Associations

3.3 Relationship between supply and use tables and national accounts aggregates

The main tool to balance the three independently produced GDP estimates are annual supply and use tables at current prices and at constant prices. The process of balancing these supply and use tables and GDP estimates involves a number of steps. These may start as independent steps or be linked with each other culminating in an iterative process with consistent estimates of GDP from all three perspectives.

The general arguments in favour of integrating supply and use tables in the compilation of the national accounts are widely recognised. At present most countries are using this technique to some extent. The argument against a full integration is often based on the belief that the approach is rather resource demanding. However the experience of countries that have implemented a full integration shows that once established – with the appropriate techniques – this is not the case.

In general, most macroeconomic data of the national accounts are based on observed survey data and annual reports. When no such data are available, use is made of indirect estimations methods or extrapolated base-year estimates applying a combination of volume and price indicators. Due to the specific data requirements, supply and use tables include more estimates than the more aggregate sector accounts. But it is also worth noting that supply and use tables contain all information of the sector accounts.

For all empirical tables in the manual the data were aggregated to the 6 products and industries of Table 3.1.

Table 3.1: Classification of products and industries in empirical tables

Products (P6)

No.	Reference CPA 2002	Description	Products (short term)
1	A + B	Products of agriculture, hunting and forestry; fish + other fishing products	Products of agriculture
2	C + D + E	Products from mining and quarrying, manufactured products; energy products, gas, water	Products of industry
3	F	Construction work	Construction work
4	G + H + I	Wholesale and retail trade, repair services, hotel and restaurant services, transport and communication services	Trade, hotel, transport services
5	J + K	Financial intermediation services, real estate, renting and business services	Financial, real estate, business services
6	L to P	Other services	Other services

Industries (A6)

No.	Reference NACE rev.1.1	Description	Industries (short term)
1	A + B	Agriculture, hunting and forestry; fishing	Agriculture
2	C + D + E	Mining and quarrying, manufacturing, energy, gas and water supply	Industry
3	F	Construction	Construction
4	G + H + I	Wholesale and retail trade; repair of motor vehicles and household goods, hotels and restaurants; transport and communication	Trade, hotel, transport
5	J + K	Financial intermediation, real estate, renting and business activities	Finance, real estate, business activities
6	L to P	Other service activities	Other service activities

The first step in the balancing procedure is to balance supply and use of goods and services. The CPA comprises approximately 3,150 products. Ideally each product should be balanced in terms of supply and demand in the system of national accounts. Table 3.2 demonstrates which information is required to balance supply and use of goods and services at purchasers' prices.

For each product total supply is estimated from total output at basic prices, imports CIF and the corresponding trade and transport margins and the net taxes on the specific product. On the use side, total use is allocated to the various categories of final demand. Remaining differences have to be allocated to supply and use or vice versa.

Box 3.2: Main approaches for the calculation of gross domestic product[2]

Supply table at basic prices, including a transformation into purchasers' prices

No	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)							IMPORTS				VALUATION		
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total	Intra EU imports CIF	Extra EU imports CIF	Imports CIF	Total supply at basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Products of agriculture	6 467						6 467	1 039	874	1 912	8 380	1 903	- 262	10 021
2	Products of industry	889	111 350	626	2 749	62	248	115 925	48 544	24 269	72 812	188 737	36 181	15 988	240 906
3	Construction work	140	1 132	27 356	429	36	67	29 161	217	143	360	29 521		1 704	31 225
4	Trade, hotel, transport services	150	3 375	399	79 355	447	439	84 164	2 044	1 512	3 557	87 721	- 38 085	1 696	51 332
5	Financial, real estate, business serv.	13	1 428	211	1 953	66 939	416	70 961	3 580	1 493	5 073	76 033		2 722	78 756
6	Other services	4	58	5	200	2	55 843	56 112	559	281	840	56 952		850	57 802
7	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790	55 983	28 571	84 554	447 344	0	22 699	470 043
8	CIF/ FOB adjustments on imports								- 133	- 30	- 163	- 163			- 163
9	Direct purchases abroad by residents								4 997	3 160	8 157	8 157			8 157
10	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790	60 847	31 701	92 548	455 338	0	22 699	478 037
11	- Market output	7 316	116 860	26 747	84 093	55 010	20 461	310 486				310 486			310 486
12	- Output for own final use	164	478	1 850	560	12 260	758	16 070				16 070			16 070
13	- Other non-market output	184	6		34	216	35 794	36 234				36 234			36 234

Use table at purchasers' prices

No	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)							FINAL USES									
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	1 705	4 104	30	482	11	95	6 426	2 561		176	108		242	397	112	3 595	10 021
2	Products of industry	1 678	55 020	9 212	14 043	3 701	7 730	91 384	55 434		2 111	22 231	163	792	42 232	26 561	149 522	240 906
3	Construction work	99	542	1 993	950	3 695	1 445	8 724	1 032			20 761			429	280	22 501	31 225
4	Trade, hotel, transport services	83	4 420	401	11 129	1 321	1 493	18 847	26 586		328	67			3 285	2 223	32 488	51 334
5	Financial, real estate, business serv.	171	7 400	1 732	10 490	21 810	4 618	46 221	22 156		195	4 254		- 24	3 606	2 345	32 533	78 754
6	Other services	102	1 323	77	813	1 682	3 052	7 049	9 507	3 670	36 988	251	61		187	90	50 753	57 802
7	Total	3 837	72 808	13 445	37 907	32 221	18 433	178 652	117 274	3 670	39 797	47 672	224	1 009	50 135	31 611	291 392	470 043
8	CIF/ FOB adjustments on exports														- 133	- 30	- 163	- 163
9	Direct purchases abroad by residents								8 157								8 157	8 157
10	Domestic purchases. by non-residents								- 12 360						9 528	2 832		
11	Total	3 837	72 808	13 445	37 907	32 221	18 433	178 652	113 071	3 670	39 797	47 672	224	1 009	59 530	34 413	299 386	478 037
12	Compensation of employees	504	25 517	8 298	26 129	14 458	32 269	107 174										
13	Other net taxes on production	- 906	908	345	981	883	810	3 021										
14	Consumption of fixed capital	1 520	6 407	1 007	6 634	9 363	4 642	29 574										
15	Operating surplus, net	2 709	11 705	5 501	13 036	10 561	859	44 370										
16	Value added at basic prices	3 826	44 536	15 152	46 779	35 265	38 580	184 138										
17	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790										

2 All figures - here and in the following tables - in millions of euros (m EUR)

Calculation of gross domestic product

Production approach		Income approach		Expenditure approach	
Total output at basic prices	362 790	Compensation of employees	107 174	Household final consumption expenditure	113 071
- Intermediate consumption	- 178 652	+ Other net taxes on production	3 021	+ NPISH final consumption expenditure	3 670
		+ Consumption of fixed capital	29 574	+ Government consumption expenditure	39 797
		+ Net operating surplus	44 370	+ Gross fixed capital formation	47 672
				+ Acquisitions less disposals of valuables	224
= Gross value added at basic prices	184 138	= Gross value added at basic prices	184 138	+ Changes in inventories	1 009
				+ Exports of goods and services	93 943
+ Taxes less subsidies on products	22 699	+ Taxes less subsidies on products	22 699	- Imports of goods and services	- 92 548
= Gross domestic product	206 837	= Gross domestic product	206 837	= Gross domestic product	206 837

Austria 2000

The final balancing of the supply and use system is an iterative procedure addressing row imbalances, then column imbalances, then row imbalances, and again column imbalances until the following goals are achieved:

- For each product — total supply = total demand
- For each industry — total inputs = total outputs
- For gross value added of each industry — production approach = income approach

Table 3.2: Balancing supply and use of products

CATEGORIES / PRODUCTS (CPA)			SUPPLY								USE									
			Output at basic prices	Intra EU imports CIF	Extra EU imports CIF	Trade margins	Transport margins	Taxes on products	Subsidies on products	Supply at purchasers' prices	Intermediate consumption	Final consumption expenditure by households	Final consumption expenditure by non-profit institutions	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total use at purchasers' prices
No	Code		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	11111	Durum wheat																		
2	11112	Wheat, except durum wheat																		
3	11220	Maize																		
:	:	:																		
:	:	:																		
3150	981010	Undiff. goods produced by private households																		
3151	98210	Undiff. services produced by private households																		
3152	990010	Services provided by extra-territorial organisations																		
		Total																		

Box 3.2 explains how GDP can be derived from a balanced supply and use system. On the basis of an empirical example from Austria it is shown how GDP can be compiled by applying the production, income and expenditure approaches.

Calculation of GDP with the production approach

Total output of industries is reported in the last rows of the supply and use tables. Value added at basic prices is calculated as a residual variable by deducting intermediate consumption at purchasers' prices from output at basic prices. To arrive at GDP at market prices, taxes less subsidies on products as reported in the supply table have to be added to value added at basic prices.

Calculation of GDP with the Income approach

In the income approach value added at basic prices is estimated on the basis of its components. The information on compensation of employees, other net taxes on production, consumption of fixed capital and net operating surplus is extracted from the use table. As intermediates are reported at purchasers' prices including net taxes on products, the information on taxes less subsidies on products has to be extracted from the supply table to calculate GDP.

Calculation of GDP with the expenditure approach

The required information on final demand is derived from the last row of the use table. Final demand in the use table is reflected by domestic and imported goods and services. To calculate GDP according to the expenditure approach total final demand has to be reduced by total imports as reported in the supply table.

The supply and use tables contain all the flows of the goods and services account, the production account and the generation of income account.

Basically, the goods and services account for the total economy can be seen as highly aggregated supply and use tables without a breakdown by product or industry (sector). In supply and use tables the goods and services account for the total economy is broken down in two dimensions: in the rows by products and in the columns by industry and by final uses by categories. Further disaggregations of final uses are the mentioned matrices for consumption expenditure by purpose (COICOP), government consumption according to main functions of the government (COFOG) and the investment matrix identifying the producing industry and investing industry for gross capital formation.

Table 3.3: A simplified table linking the supply and use tables to the sector accounts

	INDUSTRIES (NACE)				Total
	1	2	...	n	
INSTITUTIONAL SECTORS					
1. Non-financial corporations					
Total output					
Market output					
Output for own final use					
Other non-market output					
Intermediate consumption					
Gross value added					
Compensation of employees					
Other net taxes on production					
Consumption of fixed capital					
Operating surplus, net					
Gross fixed capital formation					
2. Financial corporations					
Total output					
:					
Gross fixed capital formation					
3. General government					
Total output					
:					
Gross fixed capital formation					
4. Households					
Total output					
:					
Gross fixed capital formation					
5. Non-profit institutions serving households					
Total output					
:					
Gross fixed capital formation					
6. Total					
Total output					
:					
Gross fixed capital formation					

In consequence, the goods and services account for the total economy can directly be compiled from the supply and use tables by appropriate aggregation. In addition by using the breakdown of value added by components in the use table, the production account and the generation of income account can easily be compiled from the supply and use system.

The third data set of the ESA 1995 input-output framework are tables linking the supply and use tables to the sector accounts. A characteristic feature of the system is the use of two types of units and two ways to subdivide the economy. Both are quite different and serve different analytical purposes. In order to describe income, expenditure and financial flows, and balance sheets, the system uses institutional units which, on the basis of their principal functions, behaviour and objectives, are grouped into five main sectors (non-financial corporations, financial corporations, general government, households, and non-profit institutions serving households). For the institutional units, the full set of accounts is covered in the system. A simplified version of such a link table is shown in Table 3.3**,** listing all five main institutional sectors.

For describing the processes of production (and for input-output analyses), the system uses local kind-of-activity units which on the basis of their main type of activity are grouped into industries. For the local kind-of-activity units, only a limited set of accounts is feasible, namely those accounts of the supply and use framework.

In order to show the relationships between the accounts of the production processes and the accounts of the institutional level, a link table is an integrated part of the system. In this link table, a cross-classification of output, intermediate consumption, components of value added (and possible other variables of industries) between the industries and the institutional sectors is shown. This link table should help to ensure consistency of data compiled on the basis of local kind-of-activity units and on the basis of institutional units. As both units are classified differently, the link table also provides a picture of the relations of output, intermediate consumption, value added, etc., originating in the different industries and institutional sectors.

3.4 Methodological advantages of supply and use tables as an integral part of the compilation of national accounts

As already mentioned, there are a number of advantages of producing supply and use tables as an integral part of the national accounts work. In general those advantages are strongly correlated with the level of detail with which the supply and use tables are constructed. In particular a detailed breakdown by products is important. A more disaggregated product level ensures a higher degree of homogeneity of the individual product and therefore better possibilities for determining categories of uses, price development etc. of the product. In general, a greater number of products will improve the product balances. The most detailed regularly produced supply and use tables in the European Union contain up to 3000 products.

If the product level is too aggregated, the individual products will be very broad and heterogeneous. This will considerably diminish the advantages of supply and use tables and in many cases require additional statistical information on the uses at the product level.

From a methodological point of view the following advantages can be emphasised:

1. Supply and use tables offer an ideal framework for the integration of the various approaches to calculate GDP. In particular the equality between supply and use at the level of individual products ensures a strong integration of the system of accounts.

2. Sometimes it is almost impossible to know which macroeconomic aggregates can be adjusted if statistical discrepancies are observed between independently determined supply and use levels of goods and services. The study of the supply and use system on the detailed product level is a powerful means of identifying the areas for adjustments.

3. Supply and use tables enable an efficient confrontation of different primary sources. Inconsistencies between the different primary sources can be detected in many cases by incorporating detailed information from primary sources into a common framework. The approach provides a firm ground for making appropriate corrections of the information from primary sources.

4. In cases where statistical information is missing for certain transactions (for example for gross fixed capital formation or for private consumption), alternative estimates can be made in a transparent way using the framework of supply and use tables. This is not an ideal situation because it weakens the restrictions built into the framework, but it allows the national accounts to be compiled even in situations where the statistical sources are incomplete or contradicting.

5. Supply and use tables contain the full framework for establishing the connection between the various valuation concepts in national accounts. It involves the distribution of margins, taxes and subsidies on products for the transformation from basic prices to producers' prices and finally to purchasers' prices.

6. Detailed supply and use tables also offer the best framework for the calculation of GDP in constant prices. It is the ideal framework for deflating macroeconomic data. One of the central recommendations in the "Handbook on price and volume measures" is indeed to use the supply and use framework for constant price calculations.

7. Supply and use tables at basic prices are the basis for the construction of symmetric input-output tables. Input-output tables and less often supply and use tables are often used in the database of macroeconomic models with sector disaggregation.

3.5 Practical advantages of supply and use tables as an integral part of the compilation of national accounts

In the current production of national accounts, the integration of supply and use tables offers a number of practical advantages. All have considerable effect on the overall quality of the national accounts and include the following:

1. The supply and use framework offers new options for incorporating all existing information. This is also true for information that is only periodically available.

2. A detailed rectangular supply and use framework allows the incorporation of detailed information of the primary sources. It maximizes the exploitation of information from primary sources.

The incorporation of all basic sources into the supply and use framework establishes a good foundation for making reliable estimates. Many plausible restrictions are built into the framework. Examples for these immanent restrictions are that supply equals use at the product level or that the sum of products allocated to intermediate consumption of an industry should be equal to total intermediate consumption of that industry (e.g. based on accounting statistics). If a detailed product classification is used it will be possible to apply "common sense" more effectively. It is one benefit of the commodity-flow method that the more homogenous a product actually is the easier the allocation and distribution to industries or categories of final demand actually will be.

When supply and use tables are produced as an integral part of the national accounts it is relatively easy to compile symmetric input-output tables, provided one of the standard assumptions is used. Even if a more complicated technology assumption is used, the information necessary to set up the symmetric input-output table is readily available in the form of the supply and use tables at basic prices. Supply and use tables and derived input-output tables have the important advantage that the tables are totally compatible and consistent with all national accounts figures. This feature adds a lot to the credibility and analytical usefulness of supply and use tables and input-output tables.

Supply and use tables consistent with the national accounts are normally produced in connection with the final versions of the macroeconomic data; normally 2-3 years after first preliminary results of the national accounts were published. However, supply and use tables can also play a vital role in the production of preliminary annual or even quarterly accounts. Once the supply and use system is in place on an annual basis, the benefits are significant.

This role can take various forms. One possibility could be to update supply and use tables – eventually in a more aggregated version – from the last year with information available for the preliminary year in order to have a complete set of supply and use tables available that are consistent with the preliminary figures. This procedure is a good method for revealing inconsistencies in the aggregated preliminary figures. Another possible role of supply and use tables could arise from new information. In a situation in which new and more detailed information on total supply and exports is available at an early stage, the structure of supply and use tables of the previous year could be used to project supply and use tables for domestic output and imports.

3.6 Resources

When discussing the resources and manpower requirements for a full integration of supply and use tables in the compilation of national accounts, it is essential to distinguish between the first compilation of the supply and use system, the current production of supply and use tables and the process around major backward revisions.

A substantial amount of resources is required to build up an integrated supply and use framework for the first time. This work involves establishing all the individual product balances, the development of appropriate techniques for incorporating the primary sources and new software for handling the supply and use system. The investment may lead to considerable changes in the working procedures towards a better integration of activities.

The resources needed for establishing of an integrated supply and use framework should, however, be seen in connection with the fact that the ESA 1995 data transmission programme requests submission of annual supply and use tables. The submission of annual supply and use tables is mandatory whether supply and use tables are fully integrated into the national accounts or not.

When it comes to current production the situation changes: The appropriate techniques have been developed and the trends of structural change during the previous years can be used if no new information is available. However, it is recommended to compile every five years a benchmark system of supply and use tables which is based on specific survey results.

The experience from countries which have integrated the supply and use framework into the current compilation of national accounts suggests that the resources needed are approximately the same as the resources for those countries who follow a more traditional approach. Reflecting that symmetric input-output tables are produced with relatively few additional resources if supply and use tables are in place, the resource question might even turn in favour of an integrated approach.

Occasional or major revisions of national accounts usually carried out every 5, 10 or 15 years require more resources if the revision is implemented on the basis of a large supply and use system. A revision at a more aggregated level is always easier and less demanding. One way of circumventing this problem is to make revisions only at the aggregated level. However, in this case a long time series of annual supply and use tables will be interrupted. Another possibility is to revise the supply and use tables at a more aggregated level than for the regular supply and use tables. A third option is to carry out the revisions at the level of symmetric input-output tables.

The supply table

chapter 4

4.1 Introduction

A supply table shows the supply of goods and services by type of product of an economy for a given period of time. It distinguishes between the output of domestic industries and imports. The valuation matrices for trade and transport margins and taxes less subsidies on products allow a transformation of supply from basic prices to purchasers' prices.

ESA 1995 requires the supply table at basic prices including a transformation into purchasers' prices (Table 4.1). The supply table contains three important matrices: the production matrix (transposed make matrix), the import matrix and the valuation adjustment matrix. The matrices have the same row structure defined by categories of products. This structure allows the horizontal aggregation of all elements from total output of industries at basic prices to total supply at purchasers' prices.

In a first step total domestic output at basic prices and imports CIF are aggregated to total supply at basic prices. In a second step the valuation vectors of trade and transport margins and taxes less subsidies on products are added to total supply at basic prices to arrive at total supply at purchasers' prices.

Table 4.1: Supply table at basic prices, including a transformation into purchasers' prices

INDUSTRIES (NACE) / PRODUCTS (CPA)		OUTPUT OF INDUSTRIES (NACE)							IMPORTS				VALUATION		
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total domestic output at basic prices	Intra EU imports CIF	Extra EU imports CIF	Imports CIF	Total supply at basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Products of agriculture	Production matrix						Domestic output	Import matrix		Imports cif	Total supply at basic prices	Valuation matrix		Total supply at purchasers' prices
2	Products of industry														
3	Construction work														
4	Trade, hotel, transport services														
5	Financial, real estate, business														
6	Other services														
7	Total	Total output of industries at basic prices							Imports CIF				Total		
8	CIF/FOB adjustments on imports														
9	Direct purchases abroad by residents														
10	Total	Total output of industries at basic prices							Imports FOB				Total		
11	- Market output														
12	- Output for own final use														
13	- Other non-market output														

In the supply and use system imports are valued FOB. However, data on imports by product from foreign trade statistics are most usually valued at CIF prices. Therefore, an extra row for CIF/FOB adjustments on imports is added which is used to reconcile the different valuations of imports with a global negative CIF/FOB adjustment in the import column. Another extra row is added to the supply table for direct purchases abroad by residents. Both extra rows are required to derive gross domestic product at market prices from the supply and use system.

A distinction is made in the supply and use system between market output, output for own final use, and other non-market output. Actually, three separate full size supply tables should be compiled for producers of market output, non-market output, and own-account producers of output for own final use. These supplementary rows of the supply table make it possible to add together services of health services or education services from both market and other non-market producers to arrive at output totals for these groups of services. This separation allows a clear identification of market output and non-market output. In consequence government services are distributed in the new system to the various activities in which the government is engaged, however, mainly to public administration services, education services and health services.

Table 4.2: Empirical example of a supply table[3]

	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)							IMPORTS				VALUATION		
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total domestic output at basic prices	Intra EU imports CIF	Extra EU imports CIF	Imports CIF	Total supply at basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Products of agriculture	6 467						6 467	1 039	874	1 912	8 380	1 903	- 262	10 021
2	Products of industry	889	111 350	626	2 749	62	248	115 925	48 544	24 269	72 812	188 737	36 181	15 988	240 906
3	Construction work	140	1 132	27 356	429	36	67	29 161	217	143	360	29 521		1 704	31 225
4	Trade, hotel, transport services	150	3 375	399	79 355	447	439	84 164	2 044	1 512	3 557	87 721	- 38 085	1 696	51 332
5	Financial, real estate, business	13	1 428	211	1 953	66 939	416	70 961	3 580	1 493	5 073	76 033		2 722	78 756
6	Other services	4	58	5	200	2	55 843	56 112	559	281	840	56 952		850	57 802
7	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790	55 983	28 571	84 554	447 344	0	22 699	470 043
8	CIF/FOB adjustments on imports								- 133	- 30	- 163	- 163			- 163
9	Direct purchases abroad by residents								4 997	3 160	8 157	8 157			8 157
10	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790	60 847	31 701	92 548	455 338	0	22 699	478 037
11	- Market output	7 316	116 860	26 747	84 093	55 010	20 461	310 486							
12	- Output for own final use	164	478	1 850	560	12 260	758	16 070							
13	- Other non-market output	184	6		34	216	35 794	36 234							

Austria 2000

An empirical example of a supply table is given in Table 4.2. The first and most important element of the supply table is the production matrix. It records data on the production of the economy that are classified according to two parameters: by rows the type of products (CPA) and by columns the industries (NACE). The production matrix shows in the rows the products and in the columns the industries that produce each type of the products (goods and services).

In the production matrix the domestic output of industries is reported. The output contains

- market output (revenues),
- output produced for own final demand, and
- other non-market output.

[3] All figures - here and in the following tables - in millions of euros (m EUR)

The production matrix (Table 4.3) is defined at basic prices, which means that the valuation of the production of each type of product leaves out any taxes less subsidies on products and does not consider distribution margins for trade and transportation. The production matrix reflects main and secondary production activities of industries. In statistics, survey results mainly cover enterprises with their numerous secondary activities. It is the principal activity of an enterprise that determines the allocation to a specific industry. This principal activity of an industry is reported on the diagonal of the matrix while the secondary activities of an industry are listed off the diagonal.

In the columns of the production matrix, the production programme is presented for each industry. Each column includes the output of primary and secondary productions. A production matrix only includes information on domestic output of industries by product. The principal activities of industries are reported on the diagonal of the production matrix while the secondary activities are listed off the diagonal of the production matrix.

In the same way, imports are classified by products. Although there are no strict breakdown regulations, the system suggests two types: on the one hand, a breakdown of goods and services, and on the other hand, a breakdown according to geographical origins, separating intra EU imports and extra EU imports from third countries.

Since this table is designed to show the total supply by type of products, the valuation of imports should be compatible with that of production. Imports by products, therefore, are valued at CIF prices, comparable with basic prices. Adding both components, production and imports, gives the total supply at basic prices.

Import data contain a number of adjustment rows and columns whose complementary objectives are twofold:

- to homogenise the valuation of imports by products (CIF) with the one recommended by ESA 1995 for total imports (FOB), and
- to eliminate the possible duplication of economic resources, since a part of transport and insurance services in the country is included in the CIF valuation of imported goods.

Table 4.3: Production matrix at basic prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)						
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total domestic output
No		1	2	3	4	5	6	7
1	Products of agriculture	6 467						6 467
2	Products of industry	889	111 350	626	2 749	62	248	115 925
3	Construction work	140	1 132	27 356	429	36	67	29 161
4	Trade, hotel, transport services	150	3 375	399	79 355	447	439	84 164
5	Financial, real estate, business	13	1 428	211	1 953	66 939	416	70 961
6	Other services	4	58	5	200	2	55 843	56 112
7	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790

= Primary activities

= Secondary activities

Austria 2000

Yet another item is added to imports: that of the residents' consumption in the rest of the world. This addition makes it possible to verify all imports of goods and services. Finally, valuation items on trade and transport margins and taxes less subsidies on products are added to supply at basic prices to achieve the transformation into purchasers' prices.

4.2 Compilation of the supply table

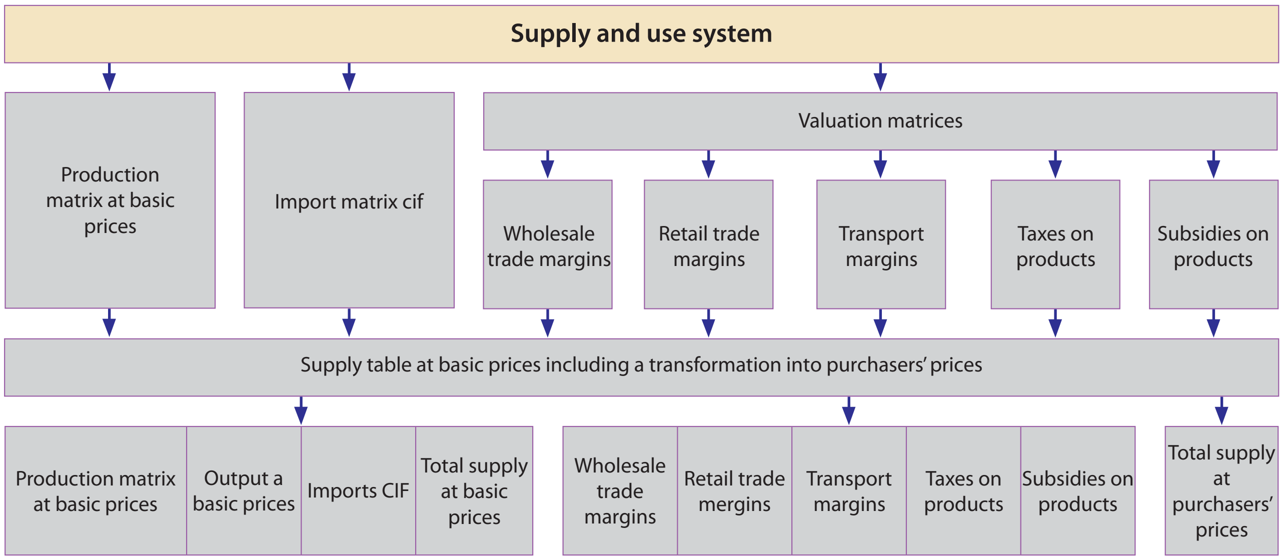
Figure 4.1 demonstrates how a supply table at basic prices, including a transformation to purchasers' prices, can be compiled. The supply table at purchasers' prices can be obtained by adding to total supply at basic prices a series of valuation matrices that allow switching from one valuation to another. The valuation vectors correspond to two types of categories: taxes less subsidies on products and distribution margins (trade and transport). Obviously, the vectors are an aggregated version of these variables which, in fact, represent full size matrices of taxes, subsidies and margins that have to be assessed for the overall compilation of the input-output framework.

In this chapter it will be explained on the basis of an empirical example how the valuation matrices can be derived from the supply and use system. In Chapter 6 of the manual (Valuation matrices), more details will be given on how the valuation matrices can be estimated for supply and use tables. In this chapter it will be shown how the vectors for trade and transport margins can be derived from the corresponding valuation matrices for the supply table.

4.2.1 Production matrix

The first task is to establish a production matrix from the survey results which is reflecting main and secondary production activities of industries. Industries are reported in the columns of the matrix and products in the rows. In statistics, survey results mainly cover enterprises with their numerous secondary activities. It is the principal activity of an enterprise that determines the allocation to a specific industry. This principal activity of an industry is reported on the diagonal of the matrix. The output contains market output (revenues), output produced for own final demand, and other non-market output.

Figure 4.1: Compilation of the supply table



In the columns of the production matrix, the production programme is presented for each industry. Each column includes the output of primary and secondary productions. The high values for trade on the diagonal of the production matrix indicate that the revenues in Table 4.4 still reflect a gross concept of trade. In this case, the output of trade services is included in the value of the traded products.

Table 4.4: Production matrix with gross trade

		INDUSTRIES (NACE)										Total
		Agricul-ture	Mining	Manufac-turing	Construc-tion	Whole-sale trade	Retail trade	Land transport	Other transport	Business activities	Other activities	
PRODUCTS (CPA)		1	2	3	4	5	6	7	8	9	10	11
1	Agricultural products	60 628	0	0	0	0	21	0	0	20	0	60 669
2	Mineral products	0	174 812	2 916	0	0	0	57	0	0	0	177 785
3	Manufacturing products	540	1 729	1 356 710	5 839	7 583	9 039	1 090	2 366	2 997	0	1 387 893
4	Construction work	448	2 932	4 501	194 132	51	0	2 517	2 484	0	400	207 465
5	Wholesale trade services	0	1 760	189 140	4 374	741 793	21 655	0	3 504	6 200	0	968 426
6	Retail trade services	0	0	14 556	0	23 401	449 527	0	99	3 039	0	490 622
7	Land transport services	0	0	0	0	0	0	14 228	0	0	0	14 228
8	Other transport services	470	1 275	0	181	0	0	2 702	174 806	0	0	179 434
9	Business services	474	3 992	29 477	734	1 042	2 628	836	2 291	800 234	0	841 708
10	Other services	0	0	0	0	0	0	0	0	0	516 070	516 070
11	Total	62 560	186 500	1 597 300	205 260	773 870	482 870	21 430	185 550	812 490	516 470	4 844 300

4.2.2 Import matrix

For the assessment of imported transport services, the access to a full size import matrix is desirable. The import matrix is also required for the transformation of the use table from purchasers' prices to basic prices and finally to input-output tables. Table 4.5 is a use table of imports which is based on empirical data.

Table 4.5: Use table of import CIF

		INDUSTRIES (NACE)										Total intermedi-ate uses
		Agricul-ture	Mining	Manufac-turing	Construc-tion	Whole-sale trade	Retail trade	Land transport	Other transport	Business activities	Other activities	
PRODUCTS (CPA)		1	2	3	4	5	6	7	8	9	10	11
1	Agricultural products	1 391	8	17 184	3	117	13		2	2 307	839	21 864
2	Mineral products	52	6 827	20 450	7	26	63	31	13	93	109	27 671
3	Manufacturing products	4 264	3 968	136 673	9 982	1 810	1 887	301	3 927	12 415	12 501	187 728
4	Construction work	2	1		26		1		1	40	13	84
5	Wholesale trade services	74	57	1 809	148	911	69	4	80	299	211	3 662
6	Retail trade services											
7	Land transport services	4	6	47	8	14	14		177	23	43	336
8	Other transport services	127	231	1 621	214	323	187	12	7 768	648	389	11 520
9	Business services	71	292	7 897	649	1 689	362	31	687	3 906	2 564	18 148
10	Other services										1 351	1 351
11	Total	5 985	11 390	185 681	11 037	4 890	2 596	379	12 655	19 731	18 020	272 364

		Total intermediate uses	FINAL USES							Total
			Private consumption	Government consumption	Gross fixed capital formation	Change in inventories	Exports of goods and services	Total final uses		
PRODUCTS (CPA)		11	12	13	14	15	16	17		18
1	Agricultural products	21 864	9 460			-98	951	10 313		32 177
2	Mineral products	27 671	515			-255	14	274		27 945
3	Manufacturing products	187 728	87 851		35 805	786	32 507	156 949		344 677
4	Construction work	84			670			670		754
5	Wholesale trade services	3 662					33	33		3 695
6	Retail trade services									
7	Land transport services	336	110					110		446
8	Other transport services	11 520	1 161		4			1 165		12 685
9	Business services	18 148	627				145	772		18 920
10	Other services	1 351								1 351
11	Total	272 364	99 724		36 479	433	33 650	170 286		442 650

4.2.3 Trade margins

Estimates on trade margins by product earned by wholesalers and retailers should be collected annually via business surveys. If this is not possible, then the following steps form an approach to establish such estimates. As trade margins are quite different for wholesale trade and retail trade, the two trade sectors are treated separately. For our example it is assumed that only agricultural, energy and manufactured products are traded. Table 4.6 demonstrates how trade margins can be estimated for wholesale trade services.

The objective is to identify the trade margins for wholesale trade services. The trade margin is defined as actual revenue realised on goods purchased for resale, minus cost of purchased products for trade.

The following approach has been implemented in Table 4.6 to verify the wholesale trade margins:

- Estimate production matrix with gross concept of trade. The trade rows include the value of the traded goods (Matrix 1).
- Determine the output relevant for trade services in the production matrix. It is assumed that only goods can be traded (Matrix 2).
- The shares of product revenues relevant for trade services in total output of goods are calculated for each industry (Matrix 3).
- The gross output of wholesale trade of Matrix 1 services is distributed to traded products (Matrix 4).
- The cost of purchased products for trade is estimated on the basis of assumed trade margins for each product (Matrix 5).
- The trade margins of wholesale trade services are estimated by deducting the cost of purchased products from the gross output of wholesale trade services (Matrix 6). The column and row totals are transferred to the supply table.

Table 4.6: Compilation of wholesale trade margins

		INDUSTRIES (NACE)										Total
		Agriculture	Mining	Manufacturing	Construction	Wholesale trade	Retail trade	Land transport	Other transport	Business activities	Other activities	
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11

1. Production matrix with gross trade

		1	2	3	4	5	6	7	8	9	10	11
1	Agricultural products	60 628					21			20		60 669
2	Mineral products		174 812	2 916				57				177 785
3	Manufacturing products	540	1 729	1 356 710	5 839	7 583	9 039	1 090	2 366	2 997		1 387 893
4	Construction work	448	2 932	4 501	194 132	51		2 517	2 484		400	207 465
5	Wholesale trade services		1 760	189 140	4 374	741 793	21 655		3 504	6 200		968 426
6	Retail trade services			14 556		23 401	449 527		99	3 039		490 622
7	Land transport services							14 228				14 228
8	Other transport services	470	1 275		181			2 702	174 806			179 434
9	Business services	474	3 992	29 477	734	1 042	2 628	836	2 291	800 234		841 708
10	Other services										516 070	516 070
11	Total	62 560	186 500	1 597 300	205 260	773 870	482 870	21 430	185 550	812 490	516 470	4 844 300

2. Output relevant for trade services

		1	2	3	4	5	6	7	8	9	10	11
1	Agricultural products	60 628					21			20		60 669
2	Mineral products		174 812	2 916				57				177 785
3	Manufacturing products	540	1 729	1 356 710	5 839	7 583	9 039	1 090	2 366	2 997		1 387 893
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	61 168	176 541	1 359 626	5 839	7 583	9 060	1 147	2 366	3 017		1 626 347

3. Shares of product revenues relevant for trade services

		1	2	3	4	5	6	7	8	9	10	11
1	Agricultural products	0.9912				0.0373	0.0373			0.0066		0.0373
2	Mineral products		0.9902	0.0021		0.1093	0.1093	0.0497				0.1093
3	Manufacturing products	0.0088	0.0098	0.9979	1.0000	0.8534	0.8534	0.9503	1.0000	0.9934		0.8534
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000		

4. Output of wholesale trade services distributed to products

1	Agricultural products					27 672	808			41		28 521
2	Mineral products		1 743	406		81 090	2 367					85 605
3	Manufacturing products		17	188 734	4 374	633 032	18 480		3 504	6 159		854 300
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total		1 760	189 140	4 374	741 793	21 655		3 504	6 200		968 426

5. Cost of purchased products for trade by wholesale trade services

1	Agricultural products					23 521	687			35		24 243
2	Mineral products		1 568	365		72 981	2 131					77 045
3	Manufacturing products		13	141 551	3 281	474 774	13 860		2 628	4 619		640 725
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total		1 581	141 916	3 281	571 275	16 677		2 628	4 654		742 012

6. Trade margins of wholesale trade services

1	Agricultural products					4 151	121			6		4 278
2	Mineral products		174	41		8 109	237					8 561
3	Manufacturing products		4	47 184	1 094	158 258	4 620		876	1 540		213 575
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total		179	47 224	1 094	170 518	4 978		876	1 546		226 414

The shaded row and column of matrix 6 are transferred to the supply table.

In Matrix 1 (Production matrix with gross trade) the empirical example is repeated. In Matrix 2 (Output relevant for trade) those revenues of the production matrix are identified which are relevant for trade.

To distribute the trade margins on the products traded, the shares of the relevant revenues are determined in Matrix 3 (Shares of product revenues for trade services). However, for wholesale and retail trade in column 5 it has been assumed that the national totals for traded products of column 11 are relevant.

In Matrix 4 (Output of wholesale trade services distributed to products) the relevant revenues of wholesale trade have been extracted from the production matrix. The output of wholesale trade is allocated to products according to the share of products in tradable products. In other words, with this assumption row 5 of Matrix 1 has been distributed to the traded goods.

In Matrix 5 (Cost of purchased products for trade by wholesale trade services) the cost of purchased goods has been estimated. If the revenues are reduced by the wholesale trade margin, the cost of purchased products for trade can be determined for wholesale trade. For the example it was assumed that the trade margins are 15% for agricultural goods, 10% for mineral products and 25% for manufactured goods. In reality the margins have to be estimated for rectangular supply and use systems with many more products than industries from survey results.

If the production costs of traded products (Matrix 5) are subtracted from the value of traded products (Matrix4) the trade margins of wholesale trade can be derived in Matrix 6 (Trade margins of wholesale trade). The trade margins reflect the costs for intermediates and value added which are required for the services of the wholesale trade. In the course of this procedure the trade margins have been allocated to the individual products which have been traded by wholesale trade services. Matrix 6 reflects the trade margins of wholesale trade services without the costs of the traded product.

The shaded results of the row 11 and column 11 of Matrix 6 are transferred to the supply table (see Table 4.13).

The same procedure has been applied for the compilation of retail trade margins in Table 4.7. The only difference is that normally higher trade margins are effective in retail trade. For retail trade it is assumed for the numerical example that the trade margins are 25% for agricultural goods, 20% for mineral products, and 35% for manufactured goods.

4.2.4 Transport margins

Transport margins have to be separately estimated for domestic transport services and imported transport services.

Domestic transport services

Transport services are allocated to products in a similar manner as trade margins. However, in the case of transport services the output is directly distributed. The value of the transported goods can be neglected as the transport company does not become the owner of the commodities. However, in the case of transportation services, the transportation margins must be separately estimated for domestic products and imported products which have been transported on domestic territory.

The following approach has been implemented in Table 4.8 to compile transport margins for domestic transportation services:

- The same production matrix is used as for compiling trade margins. The trade rows include the value of the traded goods (Matrix 1).
- Determining the output relevant for transport services. As for trade it is assumed that only goods can be transported (Matrix 2). In a supplementary row the participation rates of transported goods in the national output of goods is reported.
- The shares of product revenues relevant for transportation services in total output of goods are calculated for each industry (Matrix 3).
- The transportation margins for land transportation services of an industry are estimated by multiplying the national total output of land transportation services with the participation rate of the specific industry and the share of product revenues relevant for transportation services. (Matrix 4).

Table 4.7: Compilation of retail trade margins

		INDUSTRIES (NACE)										Total
		Agriculture	Mining	Manufacturing	Construction	Wholesale trade	Retail trade	Land transport	Other transport	Business activities	Other activities	
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11
1. Production matrix with gross trade												
1	Agricultural products	60 628					21			20		60 669
2	Mineral products		174 812	2 916				57				177 785
3	Manufacturing products	540	1 729	1 356 710	5 839	7 583	9 039	1 090	2 366	2 997		1 387 893
4	Construction work	448	2 932	4 501	194 132	51		2 517	2 484		400	207 465
5	Wholesale trade services		1 760	189 140	4 374	741 793	21 655		3 504	6 200		968 426
6	Retail trade services			14 556		23 401	449 527		99	3 039		490 622
7	Land transport services							14 228				14 228
8	Other transport services	470	1 275		181			2 702	174 806			179 434
9	Business services	474	3 992	29 477	734	1 042	2 628	836	2 291	800 234		841 708
10	Other services										516 070	516 070
11	Total	62 560	186 500	1 597 300	205 260	773 870	482 870	21 430	185 550	812 490	516 470	4 844 300
2. Output relevant for trade services												
1	Agricultural products	60 628					21			20		60 669
2	Mineral products		174 812	2 916				57				177 785
3	Manufacturing products	540	1 729	1 356 710	5 839	7 583	9 039	1 090	2 366	2 997		1 387 893
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	61 168	176 541	1 359 626	5 839	7 583	9 060	1 147	2 366	3 017		1 626 347
3. Shares of product revenues relevant for trade services												
1	Agricultural products	0.9912				0.0373	0.0373			0.0066		0.0373
2	Mineral products		0.9902	0.0021		0.1093	0.1093	0.0497				0.1093
3	Manufacturing products	0.0088	0.0098	0.9979	1.0000	0.8534	0.8534	0.9503	1.0000	0.9934		0.8534
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000		

4. Output of retail trade services distributed to products

1	Agricultural products					873	16 769			20		17 662
2	Mineral products			31		2 558	49 140					51 730
3	Manufacturing products			14 525		19 970	383 618		99	3 019		421 230
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total			14 556		23 401	449 527		99	3 039		490 622

5. Cost of purchased products for trade by retail trade services

1	Agricultural products					655	12 577			15		13 247
2	Mineral products			25		2 046	39 312					41 384
3	Manufacturing products			9 441		12 980	249 351		64	1 962		273 800
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total			9 466		15 682	301 241		64	1 977		328 430

6. Trade margins of retail trade services

1	Agricultural products					218	4 192			5		4 416
2	Mineral products			6		512	9 828					10 346
3	Manufacturing products			5 084		6 989	134 266		35	1 057		147 431
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total			5 090		7 719	148 286		35	1 062		162 192

The shaded row and column of matrix 6 are transferred to the supply table.

- The transportation margins for other transportation services of an industry are estimated by multiplying the national total output of other transportation services with the participation rate of the specific industry and the share of product revenues relevant for transportation services. (Matrix 5).
- The column totals of Matrix 4 and Matrix 5 are transferred to the supply table.

In Table 4.8 the relevant revenues for transportation are reported in Matrix 2 including the participation rates of industries in the total output relevant for transportation services. This matrix includes only the revenues of transport services for domestic products which have been transported.

Table 4.8: Compilation of transport margins for domestic transportation services

		INDUSTRIES (NACE)										Total
		Agricul-ture	Mining	Manufac-turing	Construc-tion	Whole-sale trade	Retail trade	Land transport	Other transport	Business activities	Other activities	
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11
1. Production matrix with gross trade												
1	Agricultural products	60 628					21			20		60 669
2	Mineral products		174 812	2 916				57				177 785
3	Manufacturing products	540	1 729	1 356 710	5 839	7 583	9 039	1 090	2 366	2 997		1 387 893
4	Construction work	448	2 932	4 501	194 132	51		2 517	2 484		400	207 465
5	Wholesale trade services		1 760	189 140	4 374	741 793	21 655		3 504	6 200		968 426
6	Retail trade services			14 556		23 401	449 527		99	3 039		490 622
7	Land transport services							14 228				14 228
8	Other transport services	470	1 275		181			2 702	174 806			179 434
9	Business services	474	3 992	29 477	734	1 042	2 628	836	2 291	800 234		841 708
10	Other services										516 070	516 070
11	Total	62 560	186 500	1 597 300	205 260	773 870	482 870	21 430	185 550	812 490	516 470	4 844 300
2. Output relevant for transport services												
1	Agricultural products	60 628					21			20		60 669
2	Mineral products		174 812	2 916				57				177 785
3	Manufacturing products	540	1 729	1 356 710	5 839	7 583	9 039	1 090	2 366	2 997		1 387 893
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	61 168	176 541	1 359 626	5 839	7 583	9 060	1 147	2 366	3 017		1 626 347
12	Participation rates	0.0376	0.1086	0.8360	0.0036	0.0047	0.0056	0.0007	0.0015	0.0019		1.0000
3. Shares of product revenues relevant for transport services												
1	Agricultural products	0.9912				0.0373	0.0373			0.0066		
2	Mineral products		0.9902	0.0021		0.1093	0.1093	0.0497				
3	Manufacturing products	0.0088	0.0098	0.9979	1.0000	0.8534	0.8534	0.9503	1.0000	0.9934		
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000		

4. Transport margins for land transport services

1	Agricultural products	530				2	3			0		536
2	Mineral products		1 529	26		7	9	0				1 571
3	Manufacturing products	5	15	11 869	51	57	68	10	21	26		12 121
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	535	1 544	11 895	51	66	79	10	21	26		14 228

5. Transport margins for other transport services

1	Agricultural products	6 689				31	37			2		6 760
2	Mineral products		19 287	322		91	109	6				19 816
3	Manufacturing products	60	191	149 685	644	714	853	120	261	331		152 859
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	6 749	19 478	150 007	644	837	1 000	127	261	333		179 434

The columns of matrix 4 and matrix 5 shaded in blue are transferred to the supply table.

In Matrix 3 the shares of the product revenues in total revenues are calculated for each industry. These shares will be used to allocate the rendered transport services to transported products.

In Matrix 4 the output of land transport is allocated according to the participation rates of industries in output relevant for transport services and the shares of products in transported products. The output of land transport services has been allocated to products by multiplying the value of total land transport services (14,228 m EUR) with the participation rate of the industry in transported goods and the share of the product in the revenue of the industry. For agricultural products the transport margins for land transport services are estimated at 14,228 m EUR * 0.0376 * 0.9912 = 530 m EUR.

In Matrix 5 the corresponding transport margins have been estimated for other transport services. Following the same methodology, the transport margins for other transport services are estimated at 179,434 m EUR * 0.0376 * 0.9912 = 6,689 m EUR for agricultural products.

The shaded elements of the last columns in Matrix 4 and Matrix 5 are transferred to the supply table (see Table 4.13). In the case of trade margins new rows and columns are transferred to the supply table to reflect the fact that the traders became the owner of the traded commodities. However in the case of transport margins, only the columns of Matrix 4 and Matrix 5 are transferred to the supply table indicating that the transport agencies did not become the owner of the goods.

Import of transport services

In Table 4.9 total imports CIF, total exports FOB and the resulting total net import are given. The vector of exports FOB of goods and services was extracted from the use table at purchasers' prices. The net import of transport services comprises imports and exports of transport services.

Table 4.9: Exports and imports of goods and services

		Imports CIF	Exports FOB	Net import
	PRODUCTS (CPA)	1	2	1
1	Agricultural products	32 177	5 109	27 068
2	Mineral products	27 945	3 382	24 563
3	Manufacturing products	344 677	467 979	- 123 302
4	Construction work	754	2 183	- 1 429
5	Wholesale trade services	3 695	18 133	- 14 438
6	Retail trade services	0	0	0
7	Land transport services	446	2 537	- 2 091
8	Other transport services	12 685	27 566	- 14 881
9	Business services	18 920	15 671	3 249
10	Other services	1 351	440	911
11	Total	442 650	543 000	- 100 350

The following approach has been implemented in Table 4.10 to compile transport margins for imported transportation services:

- The same production matrix is used as for compiling trade margins. The trade rows include the value of the traded goods (Matrix 1).
- Determining the output relevant for transport services. As for trade it is assumed that only goods can be transported (Matrix 2). In a supplementary row the participation rates of transported goods in the national output of goods is reported.
- The shares of product revenues relevant for transportation services in total output of goods are calculated for each industry (Matrix 3).
- Net imports are defined as total imports CIF less total exports FOB (Matrix 4).
- The imported transportation margins for land transportation services of an industry are estimated by multiplying the national total of net imports of land transportation services with the participation rate of the specific industry and the share of product revenues relevant for transportation services. (Matrix 5).
- The imported transportation margins for other transportation services of an industry are estimated by multiplying the national total of net imports of other transportation services with the participation rate of the specific industry and the share of product revenues relevant for transportation services. (Matrix 6).
- The column totals of Matrix 5 and Matrix 6 are transferred to the supply table.

Table 4.10: Transport margins for imported and exported transportation services

		INDUSTRIES (NACE)										Total
		Agriculture	Mining	Manufacturing	Construction	Wholesale trade	Retail trade	Land transport	Other transport	Business activities	Other activities	
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11
1. Production matrix with gross trade												
1	Agricultural products	60 628					21			20		60 669
2	Mineral products		174 812	2 916				57				177 785
3	Manufacturing products	540	1 729	1 356 710	5 839	7 583	9 039	1 090	2 366	2 997		1 387 893
4	Construction work	448	2 932	4 501	194 132	51		2 517	2 484		400	207 465
5	Wholesale trade services		1 760	189 140	4 374	741 793	21 655		3 504	6 200		968 426
6	Retail trade services			14 556		23 401	449 527		99	3 039		490 622
7	Land transport services							14 228				14 228
8	Other transport services	470	1 275		181			2 702	174 806			179 434
9	Business services	474	3 992	29 477	734	1 042	2 628	836	2 291	800 234		841 708
10	Other services										516 070	516 070
11	Total	62 560	186 500	1 597 300	205 260	773 870	482 870	21 430	185 550	812 490	516 470	4 844 300
2. Output relevant for transport services												
1	Agricultural products	60 628					21			20		60 669
2	Mineral products		174 812	2 916				57				177 785
3	Manufacturing products	540	1 729	1 356 710	5 839	7 583	9 039	1 090	2 366	2 997		1 387 893
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	61 168	176 541	1 359 626	5 839	7 583	9 060	1 147	2 366	3 017		1 626 347
12	Paricipation rate	0.0376	0.1086	0.8360	0.0036	0.0047	0.0056	0.0007	0.0015	0.0019		1.0000
3. Shares of product revenues relevant for transport services												
1	Agricultural products	0.9912				0.0373	0.0373			0.0066		
2	Mineral products		0.9902	0.0021		0.1093	0.1093	0.0497				
3	Manufacturing products	0.0088	0.0098	0.9979	1.0000	0.8534	0.8534	0.9503	1.0000	0.9934		
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000		

4. Exports and imports of goods and services

		Imports CIF	Exports FOB	Net import
		1	2	3
1	Agricultural products	32 177	5 109	27 068
2	Mineral products	27 945	3 382	24 563
3	Manufacturing products	344 677	467 979	- 123 302
4	Construction work	754	2 183	- 1 429
5	Wholesale trade services	3 695	18 133	- 14 438
6	Retail trade services			
7	Land transport services	446	2 537	- 2 091
8	Other transport services	12 685	27 566	- 14 881
9	Business services	18 920	15 671	3 249
10	Other services	1 351	440	911
11	Total	442 650	543 000	- 100 350

5. Transport margins for land transport services

1	Agricultural products	- 78				0	0			0		- 79
2	Mineral products		- 225	- 4		- 1	- 1	0				- 231
3	Manufacturing products	- 1	- 2	- 1 744	- 8	- 8	- 10	- 1	- 3	- 4		- 1 781
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	- 79	- 227	- 1 748	- 8	- 10	- 12	- 1	- 3	- 4		- 2 091

6. Transport margins for other transport services

1	Agricultural products	- 555				- 3	- 3			0		- 561
2	Mineral products		- 1 600	- 27		- 8	- 9	- 1				- 1 643
3	Manufacturing products	- 5	- 16	- 12 414	- 53	- 59	- 71	- 10	- 22	- 27		- 12 677
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services											
9	Business services											
10	Other services											
11	Total	- 560	- 1 615	- 12 441	- 53	- 69	- 83	- 10	- 22	- 28		- 14 881

The columns of matrix 5 and matrix 6 shaded in blue are transferred to the supply table.

The allocation of net import of transport services to products is presented in Table 4.10. The Matrices 1-3 contain the same information as for the tabulation for the domestic transportation services.

The net import of transport services is reported in Matrix 4. Net imports of -2,091 m EUR for land transport services and net imports of -14,881 m EUR for other transport services have been allocated to products. The transport margins for imported land transport services in Matrix 5 have been compiled by multiplying the total value of net imports for land transport services with the corresponding participation rates of industries and shares of products. For example, the transport margins of agriculture for agricultural products are calculated as -2,091 m EUR *0.0378*0.9912 = -78 m EUR.

The shaded elements in the last column of Matrix 5 are transferred as vector of transport margins for land transport services to the supply table. The calculation of margins for other transport services follows the same procedure. The transport margins for imported and exported products are reported in Matrix 6.

In Table 4.11 the results for domestic transportation services and imported and exported transportation services are summarised. It should be noted that in the supply and use system, trade and transport margins are allocated from trade and transport services to products. In consequence, the row total of Matrix 1 (Transport margins for land transport services) and Matrix 2 (Transport margins for other transport services) is zero.

Table 4.11: Transport margins

		INDUSTRIES (NACE)										Total
		Agriculture	Mining	Manufacturing	Construction	Wholesale trade	Retail trade	Land transport	Other transport	Business activities	Other activities	
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11
1. Transport margins for land transport services												
1	Agricultural products	608				3	3			0		615
2	Mineral products		1 754	29		8	10	1				1 802
3	Manufacturing products	5	17	13 613	59	65	78	11	24	30		13 902
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services	- 614	- 1 771	- 13 643	- 59	- 76	- 91	- 12	- 24	- 30		- 16 319
8	Other transport services											
9	Business services											
10	Other services											
11	Total	0	0	0	0	0	0	0	0	0	0	0
2. Transport margins for other transport services												
1	Agricultural products	7 244				34	40			2		7 320
2	Mineral products		20 886	348		99	118	7				21 459
3	Manufacturing products	65	207	162 099	698	773	924	130	283	358		165 536
4	Construction work											
5	Wholesale trade services											
6	Retail trade services											
7	Land transport services											
8	Other transport services	- 7 308	- 21 093	- 162 447	- 698	- 906	- 1 082	- 137	- 283	- 360		- 194 315
9	Business services											
10	Other services											
11	Total	0	0	0	0	0	0	0	0	0	0	0

The columns of matrix 1 and matrix 2 shaded in blue are transferred to the supply table.

4.2.5 Taxes less subsidies on products

The transformation from basic prices to purchasers' prices in the supply and use system requires not only a reallocation of trade and transportation margins, but also an integration of taxes less subsidies on products. This information is ideally derived from full size valuation matrices with the same columns as the use table.

Taxes less subsidies on products comprise the following valuation matrices:

- Non-deductible value added tax (VAT)
- Taxes on products, except VAT and import taxes
- Subsidies on products
- Taxes and duties on imports excluding VAT

The last column of Table 4.12 is transferred to the supply table.

Table 4.12: Taxes less subsidies on products

		Non-deductible value added tax (VAT)	Taxes on products, except VAT and import taxes	Subsidies on products	Taxes and duties on imports excluding VAT	Taxes less subsidies on products
	PRODUCTS (CPA)	1	2	3	4	5
1	Agricultural products	2 017	12 244	- 9 309	1 204	6 156
2	Mineral products	5 911	1 503		1 046	8 460
3	Manufacturing products	46 146	25 918	- 651	12 899	84 311
4	Construction work	6 898	- 1 654		28	5 272
5	Wholesale trade services	7 528	16 970		138	24 636
6	Retail trade services	5 393	6 818			12 211
7	Land transport services	473	12 219	- 12 290	17	419
8	Other transport services	5 966	- 143		475	6 297
9	Business services	27 986	- 5 013		708	23 681
10	Other services	17 159	- 4 170		51	13 039
11	Total	125 476	64 691	- 22 250	16 565	184 482

The column shaded in blue is transferred to the supply table.

4.2.6 Aggregation of the supply table

All information is now available to establish the supply table at basic prices, including a transformation into purchasers' prices. The required information by product is supply table at basic prices, vector of imports CIF, vector of trade margins, vector of transport margins and vector of taxes less subsidies on products.

Table 4.13: Supply table at basic prices, including a transformation into purchasers' prices

		INDUSTRIES (NACE)										Total output a basic prices
		Agricul-ture	Mining	Manufac-turing	Construc-tion	Whole-sale trade	Retail trade	Land transport	Other transport	Business activities	Other activities	
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11
1	Agricultural products	60 628					21			20		60 669
2	Mineral products		174 812	2 916				57				177 785
3	Manufacturing products	540	1 729	1 356 710	5 839	7 583	9 039	1 090	2 366	2 997		1 387 893
4	Construction work	448	2 932	4 501	194 132	51		2 517	2 484		400	207 465
5	Wholesale trade services		179	47 224	1 094	170 518	4 978		876	1 546		226 414
6	Retail trade services			5 090		7 719	148 286		35	1 062		162 192
7	Land transport services							14 228				14 228
8	Other transport services	470	1 275		181			2 702	174 806			179 434
9	Business services	474	3 992	29 477	734	1 042	2 628	836	2 291	800 234		841 708
10	Other services										516 070	516 070
11	Total	62 560	184 919	1 445 918	201 980	186 913	164 952	21 430	182 858	805 859	516 470	3 773 858

		Total output a basic prices	Imports CIF	Total supply at basic prices	VALUATION MATRICES						Total supply at purchas-ers' prices
					Trade margins whole-sale trade	Trade margins retail trade	Land transport	Other transport	Taxes and subsidies on prod-ucts	Total	
	PRODUCTS (CPA)	12	13	14	15	16	17	18	19	20	21
1	Agricultural products	60 669	32 177	92 846	4 278	4 416	615	7320	6 156	22 785	115 631
2	Mineral products	177 785	27 945	205 730	8 561	10 346	1802	21459	8 460	50 627	256 357
3	Manufacturing products	1 387 893	344 677	1 732 570	213 575	147 431	13902	165536	84 311	624 754	2 357 324
4	Construction work	207 465	754	208 219					5 272	5 272	213 491
5	Wholesale trade services	226 414	3 695	230 109	- 226 414				24 636	- 201 778	28 331
6	Retail trade services	162 192		162 192		- 162 192			12 211	- 149 981	12 211
7	Land transport services	14 228	446	14 674			- 16 319		419	- 15 900	- 1 226
8	Other transport services	179 434	12 685	192 119				- 194 315	6 297	- 188 018	4 101
9	Business services	841 708	18 920	860 628					23 681	23 681	884 309
10	Other services	516 070	1 351	517 421					13 039	13 039	530 460
11	Total	3 773 858	442 650	4 216 508	0	0	0	0	184 482	184 482	4 400 990

= Transferred from Tables 4.6 - 4.11

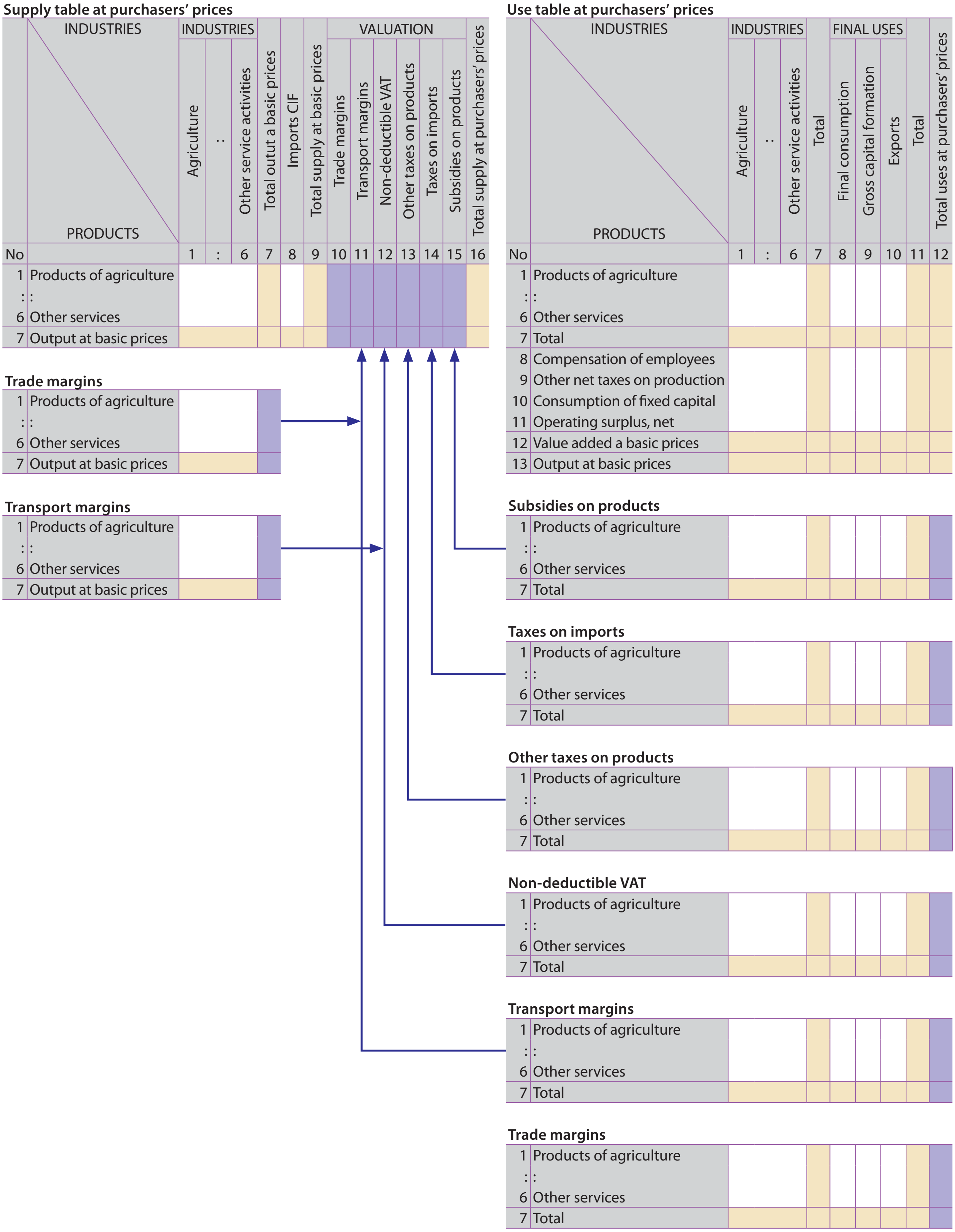
= Transferred from Table 4.12

In Table 4.13 the corresponding results for the empirical example are summarised. The supply table contains information by product on total output at basic prices, total supply at basic prices and total supply at purchasers' prices.

The compilation process of supply and use table is an integrated process. This chapter explained how supply tables at purchasers prices can be compiled if valuation matrices are available. So far we have demonstrated a procedure if matrices for trade and transport margins have been estimated for the supply side.

Chapter 6 (Valuation matrices) will discuss how a set of valuation matrices can be estimated for the use table. Figure 4.2 demonstrates how the complete process of the compilation of supply and use tables can be envisaged.

Figure 4.2: A complete process of the compilation of supply and use tables



When supply and use tables are compiled it must be noted that the sources of information for the two differ.

Normally, the production data by products which are supplied by production units are valued at basic prices, whereas imports by products from foreign trade statistics are valued at CIF prices. However, in most cases the data of the use table are valued at purchasers' prices which include the distribution margins and the net taxes on products. The valuation matrices bridge the gap between basic prices and purchasers' prices. Therefore, the valuation matrices are an integral part of the supply and use system.

4.3 Production matrix

A production matrix is restricted to information on domestic output of industries by product. An empirical example of such a table was presented in Table 4.3. The principal activities of industries are reported on the main diagonal of the production matrix while the secondary activities are listed off the diagonal.

4.3.1 Types of output

Definition of output and production borderline

Due to the relevance of output in the system of national accounts and particularly in the input-output framework, ESA 1995 contains many definitions, descriptions, criteria and topics on the subject. To avoid duplications, this manual does not deal with every single aspect of this concept.

Box 4.1 summarises some of the main criteria for the delimitation of output according to ESA 1995. However, in this box only a short summary of output topics is given; details have to be consulted in the ESA 1995 itself. On the other hand, it is not the objective of this manual to discuss "traditional" matters such as the suitability of the production boundary. In any case, in the second part of this manual, some extensions of the model will be described. The "satellite" accounts are in fact a way to extend this strict production boundary. Some further aspects will be treated in other chapters of this manual. For instance, the relationship between types of output and types of production units will be discussed in Chapter 10 (Tables linking the supply and use tables to the sector accounts).

As we know, two main types of outputs may be distinguished:

- Market output: The object in transactions between suppliers and consumers is a "market" framework, whose equilibrium is based on a *market price*.
- Non-market output, which refers to other types of production. This is subdivided in turn into two main categories: Own final use output (production whose destination is not the market but the use by the producer himself as final consumption or as gross fixed capital formation); other non-market output, which may be very roughly represented by the typical activity of general government and non-profit institutions serving households, whose production is not sold or at least not sold at an *economically significant price*.

In ESA 1995 the distinctions among types of outputs are defined while taking into account also institutional aspects and types of production units (i.e. the distinction is first defined for institutional units, then for local KAUs and then for their outputs). Trying to simplify the description in the box, these aspects will be included in Chapter 10.

Classifications used and disaggregation aspects

A crucial aspect for the construction of supply and uses tables is fixing criteria which are to be used for the matrices design in rows and columns: i.e., the disaggregation level of products (rows) and economic activities (columns).

Obviously, it is not possible to fix in advance optimum sizes for the tables, since they depend on many factors: the characteristics of the economy, what is intended to be described, statistical availabilities etc. However, to facilitate the comparability of results among countries and to determine some sort of quality standards for the tables, manuals such as ESA 1995 establish numerical criteria to define these rows and columns. In the first place, it is recommended to use classifications that are accepted on an international (or European) level: NACE for activities and CPA for products. On the other hand, recommendations are worked out regarding aggregation criteria.

Before considering these criteria, two ESA 1995 methodological aspects should be commented upon which are crucial for the compilation of the supply table and hence to the whole input-output framework: the definition of economic activity and the categories of production units.

First of all, the definition of activity in ESA 1995 is an almost direct translation of the typical concept of the theory of production.

> *An activity can be said to take place when resources such as equipment, labour, manufacturing techniques, information networks or products are combined, leading to the creation of specific goods or services. An activity is characterised by an input of products (goods and services), a production process and an output of products.*

Standard classifications, such as NACE, follow this criterion, using it as a basis for the different disaggregation and categories of activities. Therefore, it should be possible to classify any institutional unit involved in the process of production in a specific category of NACE. However, when one tries to classify institutional units (for example, corporations) according to their economic activities a problem arises: Most institutional units can carry out more than one activity. They may be engaged in one principal activity (the most important in terms of value added) and several secondary activities. An institutional unit may be involved in ancillary output. Ancillary activities are not separated from the principal or secondary activities. They are not recorded explicitly in the input-output framework.

Box 4.1: Production boundary

Output consists of the products created during the accounting period. Three types of output are distinguished in the ESA 1995:

- Market output
- Output produced for own final use
- Other non-market output

Market output consists of output that is disposed of on the market or intended to be disposed of on the market. Market output includes:

- Products sold at economically significant prices.
- Products bartered.
- Products used for payments in kind (including compensation of employees in kind and mixed income in kind).
- Products supplied by one local KAU to another within the same institutional unit to be used as intermediate inputs or for final uses.
- Products added to the inventories of finished goods and work-in-progress intended for one or other of the above uses (including natural growth of animal and vegetable products and un-completed structures for which the buyer is unknown).

Output produced for own final use consists of goods or services that are retained either for final consumption by the same institutional unit or for gross fixed capital formation by the same institutional unit.

- Products retained for own final consumption can only be produced by the household sector. Typical examples are: agricultural products retained by farmers; housing services produced by owner-occupiers; household services produced by employing paid staff.
- Products used for own gross fixed capital formation can be produced by any sector. Examples are: special machine tools produced by engineering enterprises; dwellings, or extensions to dwellings, produced by households; own-account construction, including communal construction undertaken by groups of households.

Other non-market output covers output that is provided free, or at prices that are not economically significant, to other units. Output is sold at economically significant prices when more than 50% of the production costs are covered by sales.

Therefore, it is possible to simply aggregate the institutional units in categories of activity according to NACE, taking into account each unit's principal activity. However, it is evident that such an aggregate can be tremendously heterogeneous from a production perspective.

Consequently, in order to analyse flows occurring in the process of production and in the use of goods and services, institutional units must be partitioned into smaller and more homogeneous units with regard to the kind of production. Thus, ESA 1995 defines a new type of unit: kind-of-activity unit.

The KAU groups cover all the parts of an institutional unit in its capacity as producer contributing to the performance of an activity at class level (4 digits) of the NACE and correspond to one or more operational subdivisions of the institutional unit.

In practice, one can find many companies that lack this kind of subdivisions (explicitly), but at least it is always possible to know more or less the local KAU

A local KAU groups all the parts of an institutional unit in its capacity as producer which are located in a single or closely located sites, and which contribute to the performance of an activity at the class level (4 digits) of the NACE.

The institutional unit's information system must be capable of indicating or calculating for each KAU at least the value of production, intermediate consumption, compensation of employees, the operating surplus, employment, and gross fixed capital formation. In principle, it is necessary to register as many local kind-of-activity units as there are secondary activities performed by the institutional unit. However, if the accounting documents needed to describe such activities are not available, a local kind-of-activity unit may include one or several secondary activities.

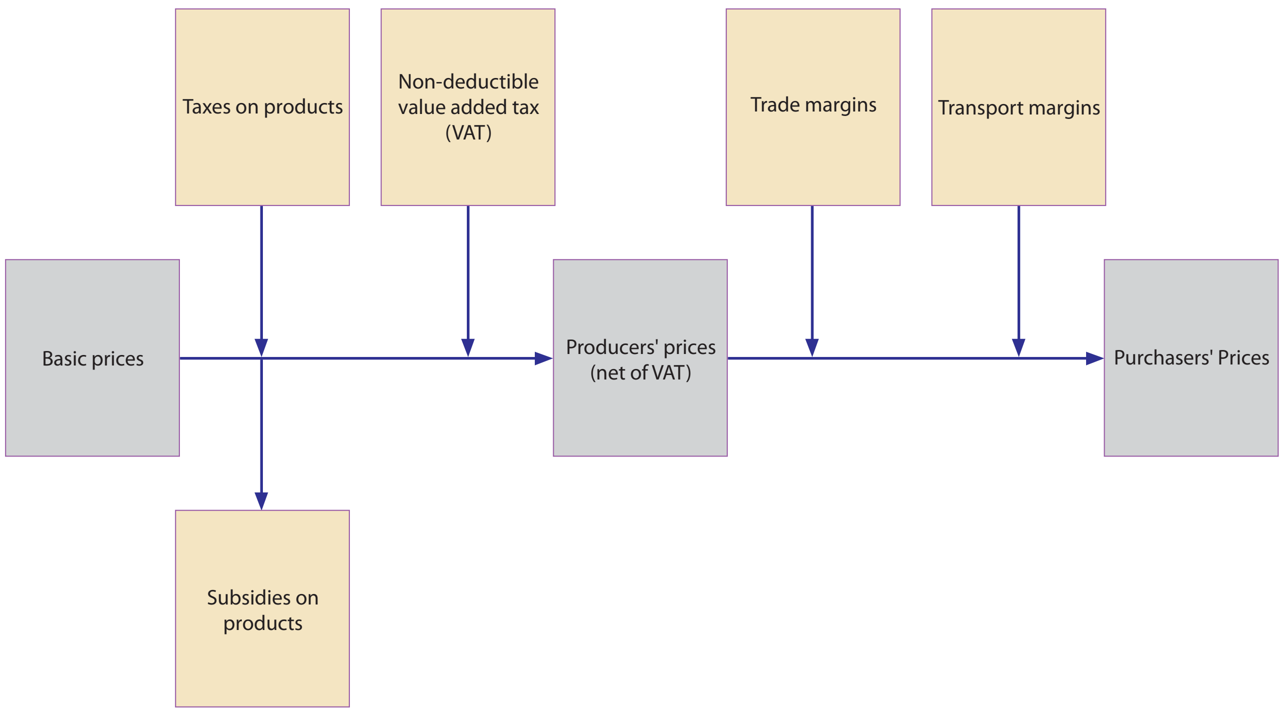
For a more detailed analysis of the production process, use is made of an analytical unit of production. This unit, which is not visible, is the unit of homogeneous production, defined as an activity covering no secondary activities. An exception is the case of a local KAU only producing one type of product.

4.3.2 Output valuation

General aspects

National accounts methodologies such as ESA 1995 combine different types of valuation for the same variable or transaction. This approach satisfies the ESA objective to show the different actual prices depending on the type of unit implied in the economic transaction. For example, a household that buys a consumer good in a shop obviously does not perceive its price in the same way as the producer who produced the good in question (and which, supposedly, is independent from its distribution). In order to allow a greater awareness of these actual subtleties, ESA 1995 sets up a series of regulations or agreements concerning the types of valuation, or as far as a crucial variable such as production is concerned, establishes the different definitions of the price that appear in Figure 4.3 (Cañada 1997).

Figure 4.3: Output valuation criteria



As shown in the diagram, a good produced can be valued, according to two main criteria: on the one hand, the purchasers' price, which is what the buyer has to pay; and on the other hand, the basic price, which is a price concept from the producer's viewpoint. Another alternative from a producers' point of view is the so-called "producer price". Producer price is an intermediate category, closer to basic price, but including taxes less subsidies on products. It is a second best approach to measure the output. Although ESA 1995 does not explicitly define "producer prices", they may be used if information at basic prices is not available. ESA 1995 and National Accounts use basic prices and purchasers' prices. However, business survey collections need to reflect that businesses' turnover will be recorded at producers' prices and adjustments will be needed to remove any taxes less subsidies on products included.

Basic, producers' and purchasers' prices are defined in the following way:

- The *basic price* is the amount receivable by the producer from the purchaser for a unit of goods or services produced as output minus any tax payable, and plus any subsidy receivable, on that unit as a consequence of its production or sale. It excludes any transport charges invoiced separately by the producer.
- The *producer's price* is the amount receivable by the producer from the purchaser for a unit of goods or services produced as output minus any VAT, or similar deductible tax, invoiced to the purchaser. It excludes any transport charges invoiced separately by the producer.
- The *purchaser's price* is the amount paid by the purchaser, excluding any deductible VAT or similar deductible tax, in order to take delivery of a unit of a good or service at the time and place required by the purchaser. The purchaser's price of a good includes any transport charges paid separately by the purchaser to take delivery at the required time and place.

The difference between these price conceptions lies in two aspects. The intermediaries in charge of distributing the product from the unit of production to the unit of consumption usually charge for their trade and transport services. At various stages of production specific taxes less subsidies on products have to be paid, for example, taxes on products such as petroleum tax, taxes on alcohol or tobacco or value added tax.

Going back to the figure, it could be said that in the case of basic prices, a good is valued by aggregating the production costs: intermediate consumption of goods and services at purchasers' prices, primary inputs (labour and capital), and other taxes less subsidies on production. If we add to the basic price the taxes less subsidies on products, we arrive at the producer price. Finally, the difference between the producer price and purchaser price is determined by the margins charged by the industries involved in distribution (trade and transport) and the value added tax (VAT).

It is evident that, among the three options of valuation mentioned, the basic price is the best option from a theoretical point of view. Except for the other taxes less subsidies on production, basic prices reflect more exactly than other price concepts the costs of all elements inherent in the product. The basic price reflects the purchase of intermediates at purchasers' prices and value added at basic prices including other taxes on production which are not related to products. The other price concepts disguise the real costs of the product and may be influenced by changes in fiscal policy or trade and transportation. However, in practice the valuation at producers' prices is often used as the second best solution, in particular when statistical information at basic prices is not available.

The ESA 1995 recommends that the valuation criteria are based on the characteristics of the different sources of information. For example, the results of household consumption surveys will reflect purchasers' prices, whereas the results of production surveys will rather identify transactions at producers' prices or basic prices. In order to match these conditions in the real situation at best, ESA 1995 introduces two optimal general regulations: total uses should be registered at purchaser prices and production at basic prices.

Besides these general criteria, however, there will be a 'to-the-point' treatment for the system's transactions and specific aspects. The following are the particular cases of production already mentioned in the previous chapter:

- Other non-market production
  Since there is no price for this production (at least a significant one) it has been decided to value it as the sum of its production costs (intermediate consumption, compensation of employees, consumption of fixed capital).

- Re-utilised production
  It should be valued at prices that would be equivalent to those it would amount to if it were sold on the market.

- Housing services of the owners of dwellings
  They are valued as the real rental price of similar dwellings.

- Production for own final use
  ESA 1995 recommends that it be valued at the basic prices of similar products sold on the market. However, as an exception, it suggests that own account construction be valued as production cost (not including the operating surplus or mixed rent).

The VAT issue is another story that requires attention. The VAT is a tax on the products which is finally paid by the consumer. According to the registration system *net-VAT* production and imports are valued without the invoiced VAT, intermediate consumption and gross capital formation without the deductible VAT, whereas final consumption includes VAT.

Box 4.2: Work-in-progress: valuation and recording in the supply and use framework

At the end of an accounting period (a year or a quarter, for example), it is possible that some part of the output may not be finished and still remain in the process of production, i.e., what is known as "work-in-progress". The main problems of this output arise in the specific cases of buildings and structures, whose production usually is not completed within a single accounting period.

In the context of supply and use tables, "work-in-progress" implies two problems: Valuation and recording criteria. Two possibilities arise, depending on the way in which the production is made:

On the one hand, when a contract of sale is agreed upon before the construction of the good (building or other structure) and the contract calls for payments in stages, the value of the output may be approximated by the value of these payments. The output produced each period is treated as sales to the purchaser at the end of the period: i.e., the purchaser's fixed capital formation rather than work-in-progress in the construction industry.

On the other hand, in the absence of a sales contract, the value may be estimated by applying the fraction of the total costs of production incurred during the relevant period to the estimated current basic price. If it is not possible to estimate the basic price of the finished structure, the estimated value is based on costs to date, including a mark-up for operating surplus or mixed income (estimated on the basis of the prices of similar buildings and structures). The incomplete output produced each period is recorded as work-in-progress of the producer.

The adoption of this system instead of other solutions is again due to the ESA's concern with the best possible adjustment to real situations. For example, in this particular case, intermediate consumption or gross capital formation of those production units (branches) subject to the normal VAT regime, appear in the table after deduction of the tax in question which is what actually occurs in the economic system. On the contrary, final household consumption expenditure does include VAT since it is impossible to deduct it.

In view of the ESA criteria, this VAT on products, which thus is the equivalent of the non-deductible VAT on purchased products, appears as a component of the goods and services accounts, necessary to balance resources and uses. Its valuation is inextricably linked with the elaboration of an input-output table or system, which is the only device which enables the study of all the aspects of an economic system burdened with VAT-type taxes.

Compilation problems

Figure 4.4 shows, in a similar way to trade and transport margins, the process of incorporation of taxes and subsidies into the supply table. From the estimates of these taxes (and subsidies), the total supply at purchasers' prices may be compiled. It should be noted that taxes (and subsidies) are also levied on the trade and transport activities. In Figure 4.4 two types of taxes are distinguished: taxes on goods (Ta) and taxes on margins (Tb).

Figure 4.4: The adjustment of the vector of taxes less subsidies on products

	Total supply at basic prices	Distribution margins (trade and transport)	Taxes less subsidies on products	Total supply at purchasers' prices
Market goods	a	+b	Ta + Tb	a + b + Ta + Tb
Trade and transport services	b	-b	0	0
Total	a + b	0	Ta + Tb	a + b + Ta + Tb

a = Output of goods and servces at basic prices
b = Output of trade and transport services (It is assumed that all transport output are margins.)
Ta = Taxes less subsidies on products
Tb = Taxes less subsidies on trade and transport services

To obtain supply of goods at purchasers' prices, both taxes have to be considered: output of goods at basic prices (a); output of trade and transport at basic prices (b); taxes on goods (Ta); and taxes on trade and transport margins (Tb). The addition of these four elements gives the price actually paid by the purchaser of a good.

In this way, total supply of trade and transport at purchasers' prices have a zero value, because the total economic value generated (including production plus taxes) is incorporated in the value of goods at purchasers' prices.

Briefly considering the practical problems with taxes (or subsidies) on products, two main issues are involved:

- On one hand, the total figures of these operations are established in the Public Accounts, which is obviously an advantage in comparison with other elements of National Accounts.
- But, on the other hand, the problem is that the input-output system requires a breakdown of these taxes by categories of products. Except in some specific cases (taxes on special products already mentioned: tobacco, alcohol, petrol etc.), the breakdown should be done in the input-output compilation process.

To make this breakdown, additional information may be used. As the legal tax rates (by products) are known, a "theoretical" estimation of taxes on each category is feasible (applying the legal tax rates to the resources at basic prices). An evaluation of the results in comparison with the amounts actually levied leads to a revision of the calculation process until a final version is obtained.

Value added tax

Among all the other elements in this vector of taxes and subsidies on products, one element is particularly important in the input-output framework: value added tax (VAT). It is a tax on "exempted activities" (activities with no obligation to pay this tax at all), a tax which mainly has to be paid by final consumers. More or less, the VAT is a tax on final private consumption. However, it should be emphasised that only when the uses of a product (the intermediate and final demand matrixes of the use table, as well as the supplementary matrix of gross fixed capital formation by industries) are known, will it be possible to estimate the non-deductible VAT on the products. Moreover, a global estimate, as it is used for other taxes, is out of place. The legal rates of VAT are known, but even a "theoretical" estimation of VAT requires some information on uses. For this tax it is necessary to estimate who buys the product.

The VAT generates a particular methodological problem in the input-output compilation and a general problem in the system of national accounts if the commodity flow method (CFM) is applied.

In simplified terms, the commodity flow method implies the following processes:

- An estimate of supply (output and imports) at basic prices.
- An estimate of trade and transport margins.

- An estimate of taxes less subsidies on products, including VAT.
- By adding the three previous items, the supply at purchasers' prices is obtained.
- Finally, each product – provided that the level of breakdown is very high – is assigned to a category of economic intermediate and final use, and even in the optimal situation, to a specific type of buyer.

In this way the use table may be estimated, starting with the commodity flow method. However, in this approach the VAT implies additional problems. In a strict definition VAT can only be estimated if some previous estimates of product demand (uses) are made. Obtaining data about industries exempted from VAT is the only way to estimate VAT. In other words, to fulfil the CFM, some previous estimation of the use table is required. Consequently, some problems of feedback arise in the process of the commodity flow method.

All these characteristics take us back to the "optimal process" for input-output compilation. Only when the compilation process starts from purchasers' prices, could data theoretically match all the requirements of ESA 1995.

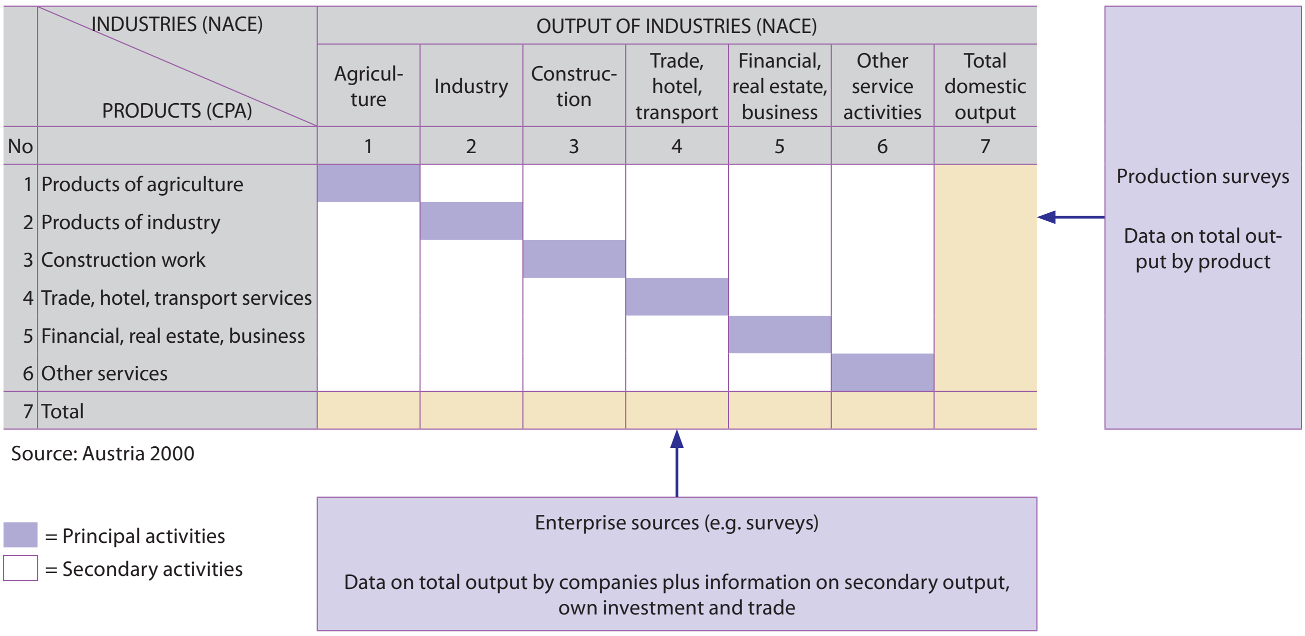
4.3.3 General compilation problems

The estimates of the production matrix are usually based on two main types of sources of information:

- Enterprise economic surveys.
- Production surveys.

The different sources of information for compiling the production matrix are presented in Figure 4.5. Starting from the enterprise economic survey, its main objective is to supply information on the main structural characteristics of the different economic activities. The main variables usually surveyed are: turnover, operating costs, investments, employees, etc. Since 1996 these statistics have been subject to a regulation in European Union countries.

Figure 4.5: Different types of information for compiling the production matrix



The basic unit of this survey is the enterprise. The population scope differs from one country to another, but it is usually exhaustive for large companies while a sampling survey is carried out for small size companies.

It is possible to estimate the total production (and some other transactions) by activity (the totals of the columns in the production table) starting from the private accounting business systems. However, some adjustments are needed in the original data to make them compatible with National Accounts definitions.

Apart from these adjustments, some other types of corrections are needed to obtain output data from enterprise survey data:

- Output for units that are not covered by the economic sources.
- Adjustments of data for misreported tax return information, when survey data for receipts shows an under-estimation of tax returns.
- Adjustments for the services industries in which partnerships and sole proprietorships are prevalent.

These items are all in connection with the need to obtain an exhaustive figure of output, covering lacks of statistical or fiscal databases.

On the other hand, the production surveys allow the estimation of the total production by commodities (the totals of the rows in the production matrix). The information unit is usually the establishment. For instance, for the industrial commodities in the European Union, the information surveyed is defined using the PRODCOM list (PRODuction COMmunity) submitted to a regulation regarding harmonisation of industrial production statistics in European Union countries, compulsory since 1995. This list is harmonised with the Foreign Trade Classification or Combined Nomenclature.

In this case, adjustments may also be necessary in the original data in order to obtain an exhaustive production figure; for example, adjustments for unrecorded units, methodological adjustments such as valuation adjustments etc.

The first problem when both sources of information are used is that the informant unit is different in each enterprise and establishment. If use is made of the information supplied by the enterprise, it should be subdivided into as many local KAUs as activities are carried out. The units under consideration should then be assigned to the corresponding industry in the classification of activities.

As far as establishments are concerned, the problem lies in the lack of global information. An establishment can only provide information on its specific activity, not on other secondary activities and therefore, the production would be underestimated. This problem is particularly critical for the elaboration of the use table since establishments may lack information regarding the enterprises' specific centralised costs such as advertising, accounting and other business services.

At this point, the classifications problem should be mentioned. The level chosen to define the input-output classification system determines the magnitude of secondary productions (and in the use tables the input structure). The ESA 1995 resolves this problem with an agreement that at present the local KAU unit is defined at class level (4 digits) of the NACE rev.1. But in practice this problem continues to exist.

On the other hand, this is the usual dilemma in the implementation of the input-output system: a more detailed classification level (greater breakdown of industries and products) and a better quality of the input-output framework can create more difficulties (statistical and methodological) in working it out.

Combining both sources of information, enterprise statistics and production statistics, it is possible to combine the data and obtain the production by products, by principal activities of the enterprise and by principal activities of the establishment that belongs to this enterprise. Thus, mainly for industrial products, the principal production and the secondary productions of a product, i.e. the entries of a row in the production matrix, may be isolated. For example, in Spain, it is possible to link the Industrial Enterprise Survey and the Industrial Production Survey, identifying the enterprises and their establishments and the activities performed by them. In this case it is possible to know the industrial production performed by industrial enterprises and by service enterprises and classify it appropriately.

In many cases the lack of information makes it necessary to use reasonable assumptions about what products are produced by the industries as secondary productions.

The main types of secondary output in most European countries are:

- Construction
  Almost all establishments may perform this kind of output. It includes: own-account gross capital formation and (current) minor maintenance and repair.

- Trade services
  Manufacturing establishments are involved both in wholesale (the most important part) and retail trade. Service establishments focus on retail trade as a secondary activity.

- Real estate
  Rental activities of real estate but also leasing of equipment.

A specific type of source may be preferred for some types of dominant activities or products. The industry information in activity-based industries is necessary for agriculture, construction, and real estate. Agriculture industries are classified by commodity, such as dairy farm products, because the quality of the source data on the production of agriculture commodities is believed to be better than data available by production units (farms).

4.3.4 Specific types of industries and products

This section does not intend to be an exhaustive catalogue of problems and methods of estimation but only to discuss the most relevant activities.

Agriculture, hunting, forestry and fishing

ESA 1995 considers production as a continuous process over time, i.e. not limited merely to the harvest of a given agricultural product or the slaughter of animals. The valuation of un-harvested crops and fruit and not yet slaughtered fish and animals farmed for human food are regarded as work-in-progress inventories, while they are being produced and as inventories of finished products as soon as the process is completed. Coherence is thus warranted between the recording of expenses and production for the compilation of significant data on value added.

In fact, only long-cycle produce needs to be recorded as work in progress (i.e. production processes that last longer than the accounts reference period). In Europe, most arable produce is yielded in a shorter time than the account period and consequently, if the produce is entered after its completion, sufficient coherence with production costs is achieved.

The most important produce for which work in progress has to be evaluated is: livestock, vegetable produce such as wine, whose ageing is part of the production process, and unpicked trees. During the production process, the value to be recorded every year as work in progress production is obtained by distributing the value of the completed produce proportionally to the expenses in each period.

One of the main evaluation characteristics of the accounts for these activities lies in the *quantity-price* approach when the yield of most products is assessed, a position that is justified by the difficulty of obtaining agricultural accounts from business accounts samples. This intricacy is caused by the still significant survival in some important regions, of small units which hamper the supply of statistical data. Instead, a minute system of quantities and prices by agricultural produce and its varieties has been set up.

Since production value is assessed at basic prices, account has to be taken of the repercussion of subsidies granted by the Common Agriculture Policy, the Common Fishery Policy, the national policies, etc., on these activities. For each product, therefore it is necessary to know the subsidies in great detail, which are then broken down into those for products and those for production.

Another characteristic of these activities is the amount of production for own final consumption. In fact, ESA 1995 recognises only three categories of own final consumption production, one of them precisely that of agricultural goods produced and used by the unit itself.

At present, and increasingly so, other kinds of secondary non-agricultural activities are arising, for which use is made of agricultural units and their means of production (equipment, installations, buildings, labour) and which should thus be evaluated. Examples are: agrotourism (camping, restoration, etc.), sports and rural leisure (soil usage for golf, riding, hunting, etc.), agricultural services for third parties, countryside preservation services, aquaculture, etc.

Construction

In NACE construction is defined as “new construction, restoration and ordinary repair” of buildings and civil engineering works. Restoration includes renovation, reconstruction and enlargement; synonymous with “major improvement” in ESA 1995. A major improvement is one that changes the performance, capacity or expected service life of a building or civil engineering work. It is this criterion which makes it different from ordinary repair or, more precisely, “regular repair and maintenance”, which is undertaken solely to maintain the construction in good working order. Regular repair and maintenance covers both major repair and maintenance undertaken by proprietors and owner-occupiers and minor repair and maintenance undertaken by owner-occupiers and tenants.

During the compilation of this kind of products, problems arise from the classification:

- On the one hand, the activity classification, NACE does not distinguish between types of construction (residential, non-residential and civil engineering). But neither does it clearly separate building activity from civil engineering activity.
- This is also the case of the products classification, the CPA (Classification of Products by Activity). Output needs to be classified at the five-digit level of the CPA in order to get the detail required on construction products. The CPA breakdown of construction products is similar, but not identical, to that in the proposed Eurostat Classification of Types of Constructions.
- Neither NACE nor the CPA make any distinction between types of work (new construction, major improvement and regular repair and maintenance).

The main aspects in the process of compiling construction are:

- The wide range of products included in this item: one-dwelling and multi-dwelling buildings, industrial and commercial buildings, motorways and railways, bridges and tunnels, airfields and harbours, pipelines and power lines, stadiums and sports grounds.
- Not only do the products vary in their complexity, they also vary in the length of time it takes to complete them which can extend over several accounting periods. Moreover, each product is in some way *unique*. For example, the construction costs of seemingly identical buildings can vary quite considerably because of variations in ground or site conditions and, hence, in foundation and working costs.
- The problem of subcontracting, which is an increasing problem to deal with in the input-output system.
- The valuation of work-in-progress.
- The borderline between major and current repairs.

Another type of problem, both from a conceptual and statistical point of view, is the particular valuation of dwellings (Figure 4.6). In fact, the purchase of this type of product is connected with many related elements: incidental expenses arising from the purchase of the building (registration, notary expenditure), payment of the purchase sale intermediaries and taxes, etc.

From the point of view of the supply table, the question is whether the purchase price of this type of product should or should not include those incidental expenses. In the affirmative, it would be necessary to introduce in the system of supply and use tables (SUT) a treatment similar to the one used for trade and transport margins, in order to avoid double accounting of these incidental services after obtaining the total resources at purchase prices.

Moreover, in this case, these products would show a zero value in the column for totals at purchase prices.

The other possibility is shown in the second part of Figure 4.6. It would consist of not including these services in the value at the purchase price of a dwelling that would only add taxes (net of subsidies) on these construction products to the value at basic prices. The services would appear explicitly, even in the valuation at purchase prices.

The sources of information for compiling this output are made up of two types of output:

- In the case of market output, supply sources are needed: Surveys of building and civil engineering contractors; physical indicators as building permits and on civil engineering work commissioned from public authorities.

- In the case of own account production, the problem is that data for all branches of activity are needed: From agricultural to services branches, through manufacturing.

Figure 4.6: The valuation of construction output

Construction purchasers' price = Total price paid by the purchaser

	Total supply at basic prices	Auxiliary column for adjustment of services	Taxes less subsidies on products	Total supply at purchasers' prices
Construction products	a	+s	Ta + Tb	a + s + Ta + Ts
Services linked to acquisition of construction products	s	-s	0	0
Total	a + s	0	Ta + Ts	a + s + Ta + Ts

Construction purchasers' price = Estimation of the total price linked to the construction output

	Total supply at basic prices	Taxes less subsidies on products	Total supply at purchasers' prices
Construction products	a	Ta	a + Ta
Services linked to purchase of construction products	s	Ts	s + Ts
Total	a + s	Ta + Ts	a + s + Ta + Ts

a = Output of construction at basic prices
b = Output of services linked to the aquistion of construction at basic prices
Ta = Taxes less subsidies on construction
Ts = Taxes less subsidies on services

Distribution services

The production of trade services is measured by means of the trade margins obtained from the resale of purchased goods.

'Commercial margin' is defined as the difference between the actual or imputed price of a good that has been purchased for its resale and the price that should be paid by the distributor to replace said good when it is sold or disposed of in any other way.

This category includes two activities:

- Wholesale trade services, which includes those units whose main activity is the sale without transformation of new or used products usually in big lots, to retailers, other wholesales, industrial or conventional consumers, import and/or export enterprises, etc.
- Retail trade services, which include those units whose main activity is the sale without transformation of new or used products to the general public for its consumption or personal or domestic use, usually in small quantities in shops, department stores, supermarkets, etc.

Concerning trade margins, the production of transport services is measured by the value of the margins charged for these services. The mentioned margins are included in the use of the products at purchase prices but are not included in the basic prices either of manufacturers or (wholesale or retail) traders of the product.

However, unlike what occurs for trade, not all the transport services supplied by units specifically engaged in this activity are margins, since one of the important changes introduced by ESA 1995 is that transport intermediation of goods may be registered under three different categories of transactions in the input-output framework:

- As transport margins of a product.
- As services paid by industries and included in their intermediate consumption.
- As services purchased by households and included in their final consumer expenditure.

The attribution to one or the other of these categories depends on the unit that pays for the transport (the manufacturer, the trader, or the household). ESA 1995 explicitly stipulates that a transport expenditure is considered as a margin if this amount is invoiced separately to the purchaser: "Transport of goods arranged by the manufacturer or by the wholesale or retail trader in such a way that the purchaser has to pay separately for the transport costs even when the transport is done by the manufacturer or the wholesale or retail trader himself".

All other costs of transporting goods are not recorded as transport margins. In some cases they will not even be recorded as transport costs. They may correspond to ancillary activities of the manufacturer or the wholesale and retail traders, when they arrange to transport the goods themselves if no separate charge is made for transportation to the purchaser; in these cases the individual costs of transport will be not identifiable as transportation costs. These transportation costs will be included in the basic prices of the manufacturer or the wholesale and retail traders.

In other cases, when there is no separate invoice or charge for this transport output, but these transportation costs are identifiable as such, they have to be recorded as part of the manufacturer's or traders' intermediate consumption. The other possibility is that these transport costs be recorded as final consumer expenditure on transport services: when a household buys goods for final consumption purposes and arranges the transportation by a third party.

This process was not considered in the former accounting system (ESA 1979) where distribution costs were tackled in general terms. In the former system it could thus occur that the treatment of transport margins was similar to that of commercial margins. That is, all the goods transport services from the place of manufacture and/or commercialisation to the place where the purchaser receives them, were considered transport margins.

Consequently, the introduction of ESA 1995 meant a very important reduction in transport margins, particularly of those converted with goods used for final consumer expenditure. This is quite logical, since households normally buy their goods – particularly the perishable ones purchased in supermarkets or department stores – at a price that does not explicitly state transportation costs. The manufacturers or the traders themselves pay the transport expenditures which are included in intermediate consumption.

When supply and use tables are elaborated, the sources of information generate a valuation of the supply table which differs from that of the use table (Figure 4.7). Normally, the production data by products supplied by the production units, based on the accounts, are valued at basic prices, whereas the imports by products stemming from foreign trade statistics are valued on CIF prices. However, the starting data of the use table (the production units' current expenditure collected through the business surveys, final consumption expenditure, etc.) are valued at purchasers' prices which means that they include distribution margins and taxes on products.

There is yet another problem: When theses margin vectors are added to the resources at basic' prices, double accounting would occur precisely of the production of the distribution intermediaries and this is valued in the corresponding rows and columns of the production matrix. In order to avoid this, the value of these margins is included with a negative sign in the rows of distribution margins.

In this way, the total of resources obtained in the overall column at the right of the table provides the data by products at purchasers' prices. As shown in the figure, the value of the margins is ultimately that of the distributed goods, so that the rows of margins show a zero value for the total at purchasers' prices.

Figure 4.7: From the basic values to the purchasers' values in the supply table

	Production matrix	Imports	Total supply at basic prices	Distribution margins (trade and transportation)	Total supply at purchasers' prices
Goods	a	-	a	b + c	a + b + c
Trade services	b	-	b	-b	0
Transport services	c + d	-	c + d	-c	d
Total	a + b + c + d	-	a + b + c + d	0	a + b + c + d

a = Output of goods at basic prices
b = Output of trade services at basic prices
c + d = Output of transport services at basic prices
c = Output of transport services reported as margins
d = Output of transport services recorder as intermediate consumption or household final consumption expenditure
Note: For simplicity is has been assumed that imports and net taxes on products are zero.

The treatment is quite similar for transport margins. In the supply table, this is represented in one or several adjustment columns (if the breakdown is made by types of trade/transport). However, a nuance may be necessary in the case of transport: The overall supply of transport services at prices does not have a zero value as shown in the figure. Instead, what will appear is that part of the transport services whose use is the intermediate consumption of the industries or the household final consumption expenditure.

Supply estimates as the second best solution

The description above establishes the best solution for compilation of distribution and tax matrixes. However, there are other possibilities for estimating these items, which, in spite of their lesser consistency, give some practical/statistical advantages: simplicity, smaller requirement of data, etc.

The main approach is the estimation of margins (and also of net taxes on products) directly in the supply table using average rates by type of product. For example, let us suppose that we can establish a global trade margin ratio (and possibly a transport ratio and a tax rate) for a specific product. In the Figure 4.8, m_1 and m_2 are the trade margin ratios for each category of goods. If we apply these ratios to the output of goods at basic prices, we obtain the value of the trade output equal to the sum of each margin: $b = b_1 + b_2$.

In fact, in this second-best procedure, the usual process is the following:

- A previous estimation of the total output of trade services (b in the figure).
- A process of estimation of each category of trade margins, as it has been described above (b_1 and b_2); by addition of each specific margin a global output is obtained ($b = b_1 + b_2$).
- A balancing process between the two previous estimations.

This procedure can be applied – with the logical nuances – to transport margins and taxes (net of subsidies) on products.

Some countries in Europe use this approach as a starting point in the input-output compilation:

- From a first estimate of total supply at basic prices.
- These countries estimate the margins and taxes upon this aggregate global procedure, obtaining total supply at purchasers' prices.
- By applying the so-called Commodity-Flow-Method, a first estimate of use categories can be implemented as a first approach to the use table.

Figure 4.8: A second-best solution for the compilation of adjustment valuation items

	Total supply at basic prices	Trade ratios by type of product (%)	Trade margins	Total supply at purchasers' prices
Goods category 1	a_1	m_1	$b_1 = a_1 * m_1$	$a_1 + b_1$
Goods category 2	a_2	m_2	$b_2 = a_2 * m_2$	$a_2 + b_2$
Trade services	$b = b_1 + b_2$	-	$-b_1 - b_2$	0
Total	a + b	-	0	a + b

a_1 = Output of goods 1 at basic prices
a_2 = Output of goods 2 at basic prices
m_1 = Trade ratio for good 1
b_1 = Output of trade services at basic prices for good 1 (equal to the sum of margins for each category)
b_2 = Output of trade services at basic prices for good 2 (equal to the sum of margins for each category)
Note: For simplicity it is assumed that net taxes on products and transport services are zero.

It is obvious that in this European Input-Output Manual, which tries to establish the most consistent and complete procedures, the first method (that is, the compilation of margins and taxes matrixes) should be recommended as the best way to compile all the elements in the System of Accounts. However, from a practical perspective, mainly in short term or provisional estimates, this kind of second best solution could be the only available. Compiling such matrices requires a considerable amount of resources and statistical sources. For instance, it is not realistic to think of an annual compilation of these matrices. But at least periodically (every 5 years) these types of matrices should be among the objectives of the National and European Institutions involved in National Accounts estimates.

Practical aspects of trade margins compilation

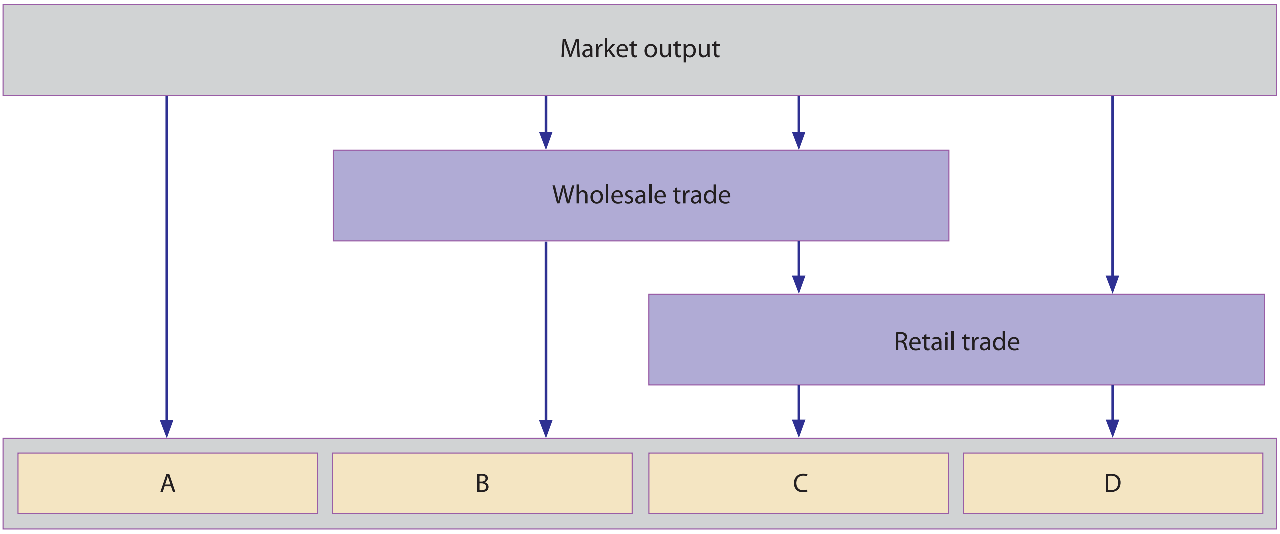
If it is decided to use the optimum elaboration procedure of a complete matrix of margins, the practical problem of estimation implies two types of sources of information or estimates:

- First, it is necessary to know the different distribution channels for each group of products.
- Second, the margin rates that have been charged at each stage of commercialisation have to be estimated.

In order to understand this process, use may be made of the following simplifying figure where account is taken of the different types of commercialisation (without intermediaries, wholesale traders, or retail traders).

Figure 4.9 shows four commercialisation channels of a product between the *producer* and the *user:* Channel A, which would be that of the producer selling directly to the buyer; channel B, when there is an intermediary wholesale trader between the producer and the buyer; channel C, when there are two commercialisation stages: the wholesaler, and the retail trader, who are those who finally direct the product to the buyer; and channel D, when the process is *producer- retail trader- buyer.*

Figure 4.9: Different distribution channels of goods



Channel A: From the producer to the user directly (without margins).
Channel B: From the producer to the user through a wholesale trader (wholesale margins).
Channel C: From the producer to the user through a wholesale trader and a retail trader (wholesale and retail margins).
Channel D: From the producer to the user through a retail trader (retail margins).

This is obviously a much-simplified presentation of what actually occurs, when the commercialisation aspects and the stages implied may be much more intricate than those described here. Neither have the imported products been tackled explicitly. For the latter, practically the same possibilities may be applied, although it has to be borne in mind that in this case some sort of wholesale intermediary is essential (a legally authorised importer).

In short, the main conclusion of this figure is the crucial need for information that allows the estimate of margins, a need that still increases, if we add the different types of uses inherent in the input-output system.

As far as the s*econd best approach* is concerned, to estimate overall margins by products, the basis should be the data of establishments (fiscal data or business surveys on specialised trade), which would make it possible to obtain an appropriate estimate. In the latter case, the fundamental problem, regardless of the availability of information, lies in the fact that data usually available on enterprises and establishments may refer to the total sales, which doubtlessly affects the accuracy of the results.

Practical aspects for the transport margins matrix

To achieve an estimate of the total transport margins by products, it will be necessary to elaborate the transport margins matrixes, where account will be taken of the different types of transport (by road, air, rail or sea). The elaboration of these matrices is an indispensable element of setting up the use table, since it is hardly possible to know the transport margins by products, if there are no data on the distribution by uses of each product starting from the use table at purchasers' prices.

For the elaboration of transport margins, the starting point will be the breakdown of the goods transport services by types of products, based on the available sources of information such as goods transport surveys by types of goods. This breakdown will be compared with the transport expenditure that the industries declare contained in the use matrix. This process is adopted because the declared transport expenditure is considered to be the equivalent of the transport of sales, since the transport expenditure of purchases appears in their purchase price.

In the first stage of estimation, the difference between the production of transport services and the expenditure by industries coincides with the product's transport margins plus household expenditure. Household expenditure on goods transport services may be estimated on the basis of household budgets surveys. However, as a consequence of the above mentioned ESA 1995 change in methodology, its weighting will be low in the total transport services. It will also be centred on a small number of specific products that may be identified through the study of the distribution channels of each group of products in the framework of the joint elaboration of the matrices for trade and transport margins.

Starting from this first estimate of the global transport margins by types of products, the matrices of the transport margins are elaborated while taking into account the distribution by uses of each product on the basis of the use table at purchasers´ prices.

Services of owner-occupied dwellings

Basic principles

For an aggregated version of this collection of activities and products, the starting point may be the current classification of activities (NACE) and products (CPA). There are three groups of activities with the corresponding types of main products.

1. Real estate activities with own property

    Development and sale of residential real estate
    Development and sale of non-residential real estate
    Residential buildings and land sales or purchases
    Non residential buildings and land sales or purchases

2. Letting of own property
3. Real estate activities on a fee or contract basis

Basic estimation principles: Self-imputation and stratification

The value of this type of product is established in the ESA independently from its application, such as: the value of the estimated rent that the tenant would pay for the same type of dwelling, bearing in mind such factors as location, size, and quality of the proper dwellings.

The main problem for the application of this accounting valuation principle is the meaning of the adjective *similar* in the case of owner occupied dwellings. In fact, two fundamentally different methods have been used:

- Self-evaluation, which is the registration of the owner calculated potential rent.
- The stratification method, which is the combination of the total stock of dwellings broken down into several strata with information on the rents paid in each stratum.

The latter method is recommended by EUROSTAT and ESA 1995, since it is more objective. The main problem with self-evaluation is that the estimates are highly subjective. This gives rise to considerable inaccuracies because of over or under-valuations (depending on circumstances) and increases the error margin of the GDP calculation proportionally to the number of owner-occupied dwellings. Furthermore, as circumstances vary, it is rather unlikely that the trend of the error margins is stable over time.

Since self-evaluation is so highly subjective, it seems reasonable from a statistical point of view to recommend the stratification method, which uses information on the real rents of dwellings to obtain an estimated value of the rents of the total number of dwellings.

It functions like this:

- Firstly, stratification is made of the *stock* of dwelling, using a division of the dwellings into a series of categories and types with a similar market rental value. This Commission recommendation points to some of the objective parameters that might be used to define the strata: characteristics of the dwelling (surface, number of rooms, equipment, etc.) and of the building (equipment, etc.) such as garages, lifts, swimming pools, gardens, etc.); type of building (single family dwelling, terraced houses or flat, architecture, age); environmental characteristics (urban and rural area, distance from an economically active centre, infrastructure and transport, shopping centres, schools, safety of the district, etc.); other socio-economic factors (public regulations for restrictions or subsidies).

- Secondly, it is necessary to establish the average rent applicable to each stratum, with the help of statistical sources or specific research.
- Finally, the average rent per stratum is applied to the number of dwellings in a specific stratum.

Obviously, when a high percentage of dwellings are owner occupied, it is not easy, under certain circumstances, to know the real rent of similar dwellings, as is required of the stratification method. The inherent difficulties in this method, i.e. the lack of real rents for a number of strata with owner-occupied dwellings, may be solved in most cases by using more sophisticated statistical methods, such as regression techniques.

Given the diversity of elements that affect the rents of dwellings, a study should first be made of which are the most influential variables. This may be done by means of a tabular analysis of the available statistical information, a tool on which most methods in Member States are probably grounded. In order to achieve an objective valuation measure, it is desirable to calculate the average quadratic derivation of a stratum's real rents, thus creating an incentive that may lead to an improved stratification through the selection of strata with a minimum average quadratic derivation.

To obtain a minimum number of principal characteristics among the countries' estimates, the Commission formulated the following standards: to use as a threshold a correlation coefficient of at least 70%; to use at least one more important element of the dwellings; to obtain at least 30 boxes, three types of sizes and two types of situations.

Secondary dwellings

This category contains all those dwellings designed for leisure, such as nearby holiday homes and those used for short periods many times a year, or more remote lodgings for longer periods but for only a few times in the year. At first sight, no problems seem to exist for rented secondary dwellings which would be subject to the same principles than the remaining dwellings.

However, the most significant problem that arises with the valuation of this kind of imputed production is the average time of occupation. In spite of this, as the Commission Decree itself acknowledges, "when difficulties arise, an alternative method involves obtaining the average annual rent of actually hired out secondary dwellings from one stratum and applying it to those secondary dwellings in said stratum occupied by their proprietors. The annual rent would implicitly show the average time of occupation. These procedures make sense if it is borne in mind that their proprietors may always dispose of them and that they may be used free of charge by relatives or friends.

Special problems: free or low-rent dwellings

The renting out of dwellings without there being any visible payment or the rent being very low (for example, an employer supplying a dwelling he owns to an employee, free or for a very low rent) is not an uncommon occurrence. Regarding tourism, this item also includes dwellings hired out for a low rent or free of charge to relatives or friends.

In these cases, the solution is to change the observed actual rent to zero. The difference between this rent and the comparable rent is considered as payment in kind and the dwellings that are classified as rented dwellings are reclassified as owner-occupied dwellings.

Non-resident owned dwellings

According to the SNA 1993 and the ESA 1995 criteria, for the purpose of national accounts and thus of the GDP measurement of an economy, non-residents owning land or dwellings (which occurs with foreigners owning holiday apartments or houses in Spain) are considered as residents to all effects; they are called *fictitious residents*. The production of these types of rents is assigned to the area or country where the dwellings are located; the use of this production would be an export of services and included in the consumer expenditure of non-residents.

Financial intermediation services

Although the matter of financial intermediation services is tackled in the chapter on the supply matrix, it should also be considered an influential factor in the supply and use subsystem.

In order to explain this type of output, it should be borne in mind that the financial intermediaries' performance is basically twofold:

- Financial services and business for which fees or commissions are explicitly charged, e.g. currency exchange and advice about investments, the purchase of real estate or advice on taxation, the output of such services is valued on the basis of the fees or commissions charge.
- Financial intermediation services for which no explicit charges are made. This output is measured, by convention, as the total property income received by the units providing the services minus their total interest payments, excluding the value of any income received from the investment of their own funds (as such income does not arise from financial intermediation). In the case of secondary insurance activities by a financial intermediary, the output excludes the income from investment of insurance technical reserves.

This second type of output causes specific definition and measurement problems in national accounts, particularly in the I/O framework. The first aspect to be emphasised is that this production is *imputed* and not explicit. Whatever its calculation, it is first and foremost an estimate since it is not directly identified with the same wording used for other market productions (a product volume and a price). Examining this question in more depth, output stems from the difference between:

- The interest charged to borrowers from financial institutions, and
- The interest payable to the depositors.

The interest charged to the former is higher than that paid to the latter, thus intermediary financiers obtain a margin in their earnings from this activity. This implicit production may, therefore, be measured globally using the data of these units.

However, it is much more difficult to measure the distribution of the product among users or consumers, for it would be necessary to know that part of *implicit* production, which is assigned to each type of use. In the context of supply and use tables, it would also be necessary to know the distribution of each industry using the services in question.

As the distribution is not easily established, ESA 79 introduced an accounting device that made it possible to use this variable for the measurement of general economic activity without the need to estimate distribution according to consumers; the creation of a fictitious branch, precisely called *imputed production of bank services* whose intermediate consumption is equal to the quantity of this *production;* a gross surplus of the same quantity but with a negative sign and consequently, a zero production.

The implication of this treatment is quite evident: although the overall balance of the economy remains unchanged, distortions are indeed introduced in the GDP figures insofar as one part of these services is assigned to final demand (final household consumption, exports). On the other hand, distortions also arise in the production structures of the branches of activity shown in the use table, according to the varying importance of this (net) consumption of financial services.

That is why, despite the fact that the final ESA 1995 text approved in 1996 still uses the fictitious branch, the EU countries, co-ordinated by EUROSTAT, have implemented an evaluation and analysis process (as well as a possible method of application) regarding the possibility or not of a FISIM attribution. The outcome of this process is the regulation on the allocation of financial intermediation services indirectly measured (FISIM)[4]. This document fixes the external reference rate and is to be applied from January 2005 onwards.

[4] Commission Regulation (EC) No 1889/2002 of 23 October 2002 on the implementation of Council Regulation (EC) No 448/98 completing and amending Regulation (EC) No 2223/96 with respect to the allocation of financial intermediation services indirectly measured (FISIM) within the European System of national and regional Accounts (ESA).

Insurance

Insurance includes a large list of products and activities. There are two main types of insurance: social insurance and other insurance. In the context of supply and use tables we will focus only on the second (other insurance) and one specific variety of the first one: privately funded social insurance schemes. There are some other activities in this field which are also interesting in the supply and use context such as "reinsurance".

"Other insurance", may be subdivided into two main types of products: other life insurance, and other non-life insurance. The output of *other insurance services*, both life and non-life, is calculated as:

Actual premiums earned
+ Premium supplements
- Claims due
- Increases (+ decreases) in technical provisions against outstanding risks and technical provisions for with-profits insurance
= Output of other insurance

'Actual premiums earned' are the actual premiums that cover the risks incurred during the current period. 'Premium supplements' are identical to property income attributed to policy holders, which is the entire income earned by insurance enterprises by investing their insurance technical reserves, excluding any income from insurance enterprises' own funds. 'Claims due' cover events that occur within the current period. Changes in technical provisions against outstanding risks and technical provisions for with-profits insurance consist of allocations to technical provisions against outstanding risks and provisions for with-profits insurance policies to build up the capital sums guaranteed under these policies. These provisions relate to life insurance only.

This activity is characterised by the fact that it is a medium/long term activity and that it is only possible to analyse it over a period of time. Insurance policies are usually paid as annuities; claims are usually paid as lump sums (in some cases, also as annuities). Obviously, the typical number of claimants is much smaller than the number of policyholders if the insurance activity is a market activity.

Reinsurance is an activity in which an insurance enterprise transfers some of the risks incurred to other insurance enterprises. Both life and non-life insurers are involved in reinsurance transactions.

Output of *privately funded social insurance schemes* is defined as:

Total actual contributions earned
+ Total contribution supplements
- Benefits due
- Increases (plus decreases) in pension fund reserves
= Output of private funded social insurance schemes

All four items are recorded exclusive of holding gains or losses. Total contribution supplements are identical to property income attributed to policy holders, which is income earned by private social insurance funds by investing their technical and pension reserves.

The ESA 1995 regards these reserves as owned by the policyholders, which therefore receive the income generated by these reserves. The service charge is recorded as output (P.1) for the autonomous funds and as final consumption expenditure (P.3) for the household sector.

Compilation problems

A general problem in the measurement of this kind of output is that all four items in the definition above should be measured excluding holding gains and losses. In practice, these adjustments are not simple.

However, from an input-output perspective, the main problem is the distribution of this output among users along the rows in the use table. As holders of other life insurance policies are exclusively households, the main problems are with non-life insurance. Non-life insurance users may be intermediate users (industries) or final users. In the second group there are two possibilities: households (final consumption expenditure); and the rest of the world (exports). Statistical sources do not provide the distribution of output as has been defined in National Accounts. Therefore, some alternative approaches are needed.

The most usual approaching method is the distribution of output in proportion to actual premiums payable by each industry or sector, information usually available in most countries. We may emphasise the character of "approach", as for an individual policy holder there is no relationship between the premiums paid and the claims received, even in the long run.

In the case of reinsurance, this output will be consumed as intermediate consumption of the insurance industry. The problem of insurance services should be mentioned here, which are included in the CIF valuation of imports.

Leasing

In ESA 195 leasing is defined in the following way:

> *When one institutional unit A owns a durable good and transfers the right to use this good to another unit B, A is said to be the 'lessor' and B the 'lessee'. Payments from B to A in exchange for the transfer of user rights are called 'rental payments'. The lessor may be identical with, or a subsidiary of, the producer or seller of the durable good, but the lessor may also be a completely independent unit with no ties to the producer or seller. All sorts of produced durable goods, from buildings and structures to consumer durables, may be the subject of leasing, and any kind of institutional unit may use leasing to obtain user rights over durable goods."*

Figure 4.10: Leasing and hire purchase – Main compilation differences

<table>
<tr><th></th><th>Operating leasing</th><th>Financial leasing</th><th>Hire purchase</th></tr>
<tr><td>The (durable) good is owned by</td><td>The lessor (as gross capital formation)</td><td>The lessee (as gross capital formation)</td><td>The purchaser (mostly households purchasing a consumer good)</td></tr>
<tr><td>The (durable) good is recorded as</td><td>Gross capital formation of the lessor</td><td>Gross capital formation - in the case the lessee is an industry - or final consumption expenditure - if the lessee is a household.</td><td>Household final consumption expenditure</td></tr>
<tr><td>The output is defined as</td><td>Rental payments from the lessee to the lessor</td><td>Financial intermediation services indirectly measured (FISIM) = Property income receivable less interest payable</td><td>FISIM</td></tr>
<tr><td rowspan="2">The Activity Code (NACE Rev. 1) is</td><td>Operating leasing of real estate: Letting of own property</td><td rowspan="2">Financial leasing</td><td rowspan="2">Other credit granting</td></tr>
<tr><td>Op. leasing of other durable goods: Renting of machinery and equipment without operator</td></tr>
</table>

There are three different types of products involved, as shown in the attached table:

- Operating leasing. When the lessor always maintains the legal administrative ownership of the asset. This activity is very similar to a rent.
- Financial leasing, when the owner is the lessee: the purchase of the asset has been financed by the lessor. An intermediary financial service is involved.
- Hire purchase. "A durable good is sold to a purchaser in return for agreed future payments. The buyer takes possession of the good immediately, though in law it remains the property of the seller or financier as collateral/guarantee until all agreed payments have been made. Hire-purchase is usually restricted to consumer durables, and most purchasers are households. Financiers of hire purchase contracts typically are separate institutional units operating in close co-operation with sellers of durable goods" (ESA 1995 Annex II, Leasing and hire purchase of durable goods.)

The main differences among these different outputs are shown in Figure 4.10: The property of the good, the operation of recording, the definition of output, and the NACE code. From a statistical point of view, the main difficulties arise in the operating leasing. It requires statistics both from supply (specialised companies) and demand perspectives (all the units in the economy). International transactions generate special problems.

Research and development

Research and development is any *creative work* carried out to increase accumulated knowledge and to improve its application. There are three types of research and development: basic, designed towards the achievement of fresh knowledge without any specific objective; applied, which does intend to reach a specific purpose; and experimental, which aims at making the most of knowledge arising from the first and/or second and endeavours to obtain more material, products or resources or to develop new procedures, systems or services or to substantially improve those already existing. To establish limits among these three fields is a rather tricky affair.

In practice, from a statistical viewpoint and regarding information supplied by enterprises, it is difficult to distinguish research and development from a series of other activities which are not research and development despite being related to it. Examples of this are routine business activities such as production tests, quality control, creation of computer programmes, etc.; patents and licenses which cover only part of R+D since not all the innovations are patented; engineering design, training of technicians, etc.

ESA 1995 establishes three types of research and development production: that carried out by market production units for sale, that carried out by these units as secondary production, and that carried out by other non-market production units.

In principle, the evaluation of production complies with that stipulated in ESA 1995, i.e. basic prices for market production and total costs for non-market production. Regarding the production by laboratories and research institutes whose purpose it is to sell, no evaluation problems occur, since it will be done, as is usual, on the basis of their accounts, income from sales, commissions, fees, etc.

In the case of research and development production for use within the enterprise itself, the evaluation principle is the basic price of similar products sold on the market. However, the essence of research and development is to be unique, meaning that a research project is performed only once with the same characteristics. Generally, this particularity makes it impossible to compare prices, it thus being necessary, in practice, to use the criterion of production costs for the secondary production in question.

The evaluation of the other non-market production units does not usually cause problems once it has been identified; the evaluation of the total costs of the other non-market production and when income is obtained from the sale of part of their production, it consequently is a secondary market production.

Other non-market output

From a compilation point or view, this kind of output is completely different from market or own final use output. First of all, this type of output involves a strong link to the institutional analysis of the National Accounts System. For other non-market output, the process of compilation of the supply and use system is also specific: The process of compilation involves three stages:

1. Use table
   Output may only be obtained as a sum of costs (intermediate consumption, compensation of employees, gross operating surplus, and other taxes less subsidies on production)

2. Supply table
   Data about market output by type of products obtained for these sectors should be collected and recorded in the supply table.

3. Non-market output
   Finally, non-market output may be obtained as a difference between the two previous stages of total output minus market output.

The definition of total output as the sum of costs has many implications:

- The main component of the costs for these activities and therefore for this output is the compensation of employees, since they need to work intensively.
- As far as intermediate consumption is concerned, it should be borne in mind that ESA 1995 has introduced an element that brought an accounting system which differs from the previous ones by treating military expenditure now as investment instead of intermediate consumption.
- One element of consumption of fixed capital should be mentioned whose re-definition is one of the ESA 1995 novelties regarding the general government. Consumption of fixed capital should also be recorded for infrastructure of the government (roads, buildings, etc.) which were not included in the calculation according to ESA 1979.

Emphasis should also be given to another aspect, closely linked to that mentioned above. Since this production is carried out by units belonging to the General Government or by *non profit institutions serving households*, the compilation should take into account the characteristics of the information stemming from these two sources.

In the case of General Government, public accounting is the main source of information, a fact which implies the need to create an intermediate system between the national accounts and Public Accounting.

Regarding NPISH, the matter is different. Usually, most of these units lack accounting or information systems that are appropriate for national accounts. The only way to overcome this drawback is to conduct specific statistical research. However, in view of these units' characteristics concerning incidental incomes (from voluntary donations) or labour, this research has its own problems. The prevalence of voluntary collaborations or those receiving no monetary compensations greatly enhances their measurement. It is also possible to resort to those General Government institutions that finance the NPISH, since granting subsidies generally implies a control of how the resources are spent. But in this case, the information is obviously used to assess these activities' total figures.

Finally, one of the difficulties for the compilation of NPISH operations is the need to clearly specify if an institution is non-profit or if it performs market activities, since some foundations have been created by groups of enterprises aiming at a reduced tax burden.

Transactions in existing goods

In an economy, purchase and sale of second hand goods is carried out. These are goods which in a former or in the current period enter the economic circuit of a country and have already undergone the transactions of production import, (intermediate or final) consumption or gross capital formation.

Examples of second-hand goods:

- Valuables (works of art, items of collections)
- Second-hand buildings and other fixed capital goods
- Second-hand durable consumption goods (cars, televisions, computers etc.)
- Second-hand non-durable consumption goods (used paper, rags, uses bottles etc.)

Transfers in existing goods are recorded as negative expenses for the seller and positive expenses for the purchaser.

The implications of transactions with second-hand goods for supply and use tables are the following:

The Supply matrix shows expenditure linked with the transference of a property as new productions of the current period, and the possible distribution margins. The imports column shows the purchase of these types of goods by resident units, and commodities which were the property of non-resident units, except real estate. In this case, the resident unit that purchases the real estate is considered a fictitious resident unit at the place of purchase and, consequently, the transaction is carried out between resident units and there is no importation.

The use matrix shows the following items:

In the *intermediate consumption* of industries, the purchase of recovered goods (i.e. the purchase of second-hand non-durable consumption goods) or material to be demolished (fixed capital or durable consumption goods, purchased to be demolished). On the other hand, public administration industries show the balance of purchases and disposals made by this administration in the field of military durable second-hand goods that will be re-used.

Household final consumption expenditure, shows the balance of purchases and assignments of second-hand goods, except valuables and real estate (which are gross capital formation).

In *fixed gross capital formation*, the balance of purchases and assignments by industries of fixed capital second-hand goods meant to be re-used and the balance of transactions with existing valuables both by industries and households.

In *changes of inventories*, negative disposals of recovered goods (i.e. assignments of non-durable second-hand consumption goods) by industries.

In *exports*, positive disposals of second-hand goods by resident units to non-resident units, except real estate; in this case, the non-resident unit which purchases the real estate is considered a fictitious resident unit and, consequently, the transaction occurs between resident units and there is no exportation.

4.4 Imports

4.4.1 Introduction: general description and definition

The definition of imports in ESA 1995 is:

> *Imports of goods and services consist of transactions in goods and services (purchases, barter, gifts or grants) from non-residents to residents. This general definition gives an intuitive notion of imports. But in reality, transactions with the rest of the world are very complicate and consist of many different transactions of which it is not easy to know whether they are imports or not. For example, ESA 1995 mentions some cases that are not included in imports (i.e. deliveries to residents by resident affiliates of foreign multinational enterprises, the sale or purchase of financial assets or non-produced assets, like land and patents, etc.).*

Therefore, as far as imports of goods are concerned (and exports as well), the following definition eliminates any ambiguity: an import transaction occurs when there are changes of ownership of goods between residents and non-residents (whether or not there are also corresponding physical movements of goods across frontiers).

However, there are four specific exceptions to the general rule: financial leasing; a change of ownership is to be imputed whenever goods are delivered between affiliated enterprises (branch or subsidiary, or foreign affiliate): goods for significant processing to order or repair are recorded both in imports and exports although no change of ownership occurs; no import or export is recorded when merchants or commodity dealers buy from non-residents and then sell again to non-residents within the same accounting period.

An additional difficulty concerns the time when a transaction is recorded. Imports and exports of goods should be recorded when the ownership of the goods is transferred. A possible practical recording criterion is at the time the parties to the transaction record it in their books or accounts. However, some problems can arise, since the time of recording in the accounts may vary according to the different stages of an import's contractual process (contract date, transfer date, payment date).

The ideal breakdown of the import matrix involves three aspects:

1. Imports characteristics classified in *goods* and s*ervices*, as their conceptual and empirical characteristics are completely different.

2. Geographical breakdown of imports and exports, according to intra-EU trade and extra-EU trade.

3. There is also the theoretical traditional classification of imports into imports of products that are also domestically produced ('competitive imports') and imports of products that are not domestically produced ('complementary imports').

This breakdown is important in terms of theoretical extensions of the input-output framework, as in the case of analysing the impact of increasing prices of imported goods (for instance, an increase of the oil price). Another more frequently discussed example is the traditional policy of substituting imports by national production.

A special category within Imports is the direct purchases abroad by residents. This item covers all purchases of goods and services made by residents while travelling abroad for business or pleasure. Two categories must be distinguished because they require different treatments:

- *Expenditure by business travellers*
  As indicated in ESA 1995, this item refers to *intermediate consumption* of the branches of activity to which the travellers belong;

- *Expenditure by other travellers on personal trips*
  This expenditure is household final consumption expenditure.

Regarding the first category, since this expenditure by business travellers is included in the expenditure of enterprises or production units, it should be recorded as intermediate consumption, but obviously as an *imported* intermediate consumption. Although these imports, considered as part of the intermediate consumption matrix, would refer to a small number of products (mainly housing and transport) they give rise to problems, more practical and statistical rather than conceptual.

Another item is added which shows consumption by residents of the rest of the world and which also allows a homogeneous overall presentation of imports data. This adjustment is shown in Figure 4.11.

Figure 4.11: The adjustment of direct purchases abroad by residents in the Supply table

	Output at basic prices	Imports	Total supply at basic prices
Total products	O	M	O + M
Direct purchases abroad by residents	-	CRA	CRA
Total	O	M + CRA	O + M + CRA

O = Output at basic prices
M = Imports CIF
CRA = Direct purchases abroad by residents

Imports broken down by products in the imports matrix (M) do not include direct purchases abroad by residents (CRA). Consequently, these have to be included in an adjustment row to obtain the overall value of imports (M+A), as recommended in ESA 1995.

As shown in the chapter on use tables, the adjustment in question should also appear in an ancillary row of the table, for the sake of balance, and also to show household final consumption expenditure in aggregated terms from a national viewpoint. ESA 1995 recommends that the expenditure incurred outside the economic territory be broken down by products: In order to obtain a balance between supply and use by product, all these purchases should be split over the various product groups involved. Or, at least, groups where these purchases are important should be shown as a subcategory, e.g. expenditure on accommodation.

4.4.2 The problems of valuation

Valuation aspects are a controversial item for imports in the input-output framework. The problem arises from the need that two different kinds of criteria be compatible:

- Aggregated criteria: Total Imports are to be valued *free on board* at the border of the exporting country (FOB price).
- Imports of goods for individual product groups by products (in the input-output framework): imports have to be valued at the *cost-insurance-freight* (CIF) price at the border of the importing country.

Before explaining this aspect from the specific input-output perspective, a short indication is given on the types of valuation for imports.

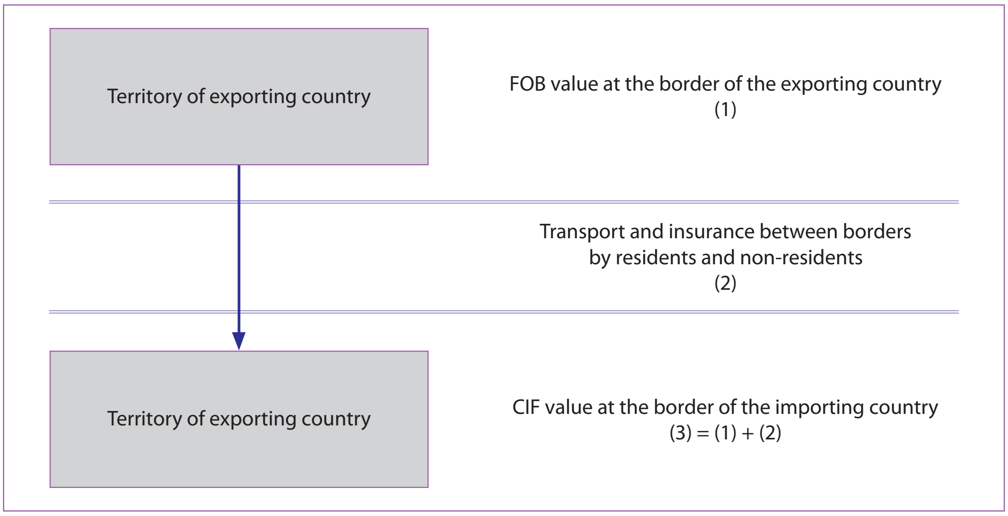
FOB prices consist of:

- the value of the goods at basic prices;
- plus the related transport and distributive services up to that point of the border, including the cost of loading onto a carrier for onward transportation (where appropriate) ;
- plus any taxes minus subsidies on the goods exported.

The import price is the price of a good delivered at the frontier of the importing country, or the price of a service delivered to a resident before the payment of any import duties or other taxes on imports or trade and transport margins within the country (ESA 1995, Par. 3.138).

According to Figure 4.12, these transactions may be performed by residents and non-residents. Regarding the former, there is an overstatement of the costs of imports, since the production of resident transporters or insurers are already included in the economy's output.

Figure 4.12: Imports valuation criteria - The CIF and FOB values



Regarding the transactions of non-residents, the problem may arise from the fact that their registration in the national accounts and in the input-output framework erroneously treats them as goods instead of services (since the total resources is calculated as the sum of outputs and imports CIF).

Consequently, these two problems need to be corrected. For the first one, double accounting has to be cut out, which will affect the value of imports, whereas the second one merely requires a rearrangement of imports (goods and services) with no repercussion on the total value.

The example in Figure 4.13 is meant to clarify the problem and its possible solution for the supply and use table. The relevant figures are recorded in a simplified structure for a supply and use system. In the figure, only goods and services transactions linked to foreign trade are presented. For the sake of simplification, taxes and subsidies are supposed to be zero. In the supply table, output of goods at basic prices is 196 units, which is the equivalent to the volume of exports at basic prices in the use table. Imports of goods at CIF prices are recorded at 250 units.

The example presents the two treatments available to transform CIF imports into FOB imports: one is brought forward in SNA 1993, the other in ESA 1995.

In the first part of the figure, the SNA 1993 criterion is represented. Data on transport and insurance services on imports and exports are recorded in the corresponding cells of the supply and use tables. In the supply table, since imports of goods are valued at CIF prices, they include transport and insurance services rendered by residents (5 units) and non-residents (8 units) engaged in these imports. These services are also recorded under imports of services. These entries are recorded on the row for transport and insurance services in the imports column. Those of residents (5 units) are in turn included in the output of the economy.

Following the SNA 1993 procedure, an auxiliary adjustment column is introduced:

- Transport and insurance services on imports that are provided by both resident (5 units) and non-resident (8 units) producers are deducted from imports CIF of goods (see entries on CIF/FOB adjustment row in the imports column), thus obtaining imports FOB. The same adjustment is included in entries in row for transport and insurance services in the CIF/FOB adjustment column.
- The adjustment row and column guarantees equilibrium, with the minus sign in the imports column, the plus sign in the adjustment column and a zero balance when total resources at basic prices are calculated.

Figure 4.13: An example of the adjustment in the valuation of imports

	RESIDENT UNITS	NON-RESIDENT UNITS
Trade		
Exports FOB of goods	200	
Imports CIF of goods	250	
Transport and insurance services linked to exports of goods		
In the economic territory	3	1
Outside the economic territory	6	9
Transport and insurance services linked to imports of goods		
In the economic territory	4	2
Between borders	5	8
In the economic territory of the exporting country	0	7

System of National Accounts 1993

Supply table

	Output at basic prices	Imports	CIF/FOB adjustment	Total supply
Goods	196	250	-	446
Transport and insurance services	3+6+5+4	1+2+8	-5-8-6	10
CIF/FOB adjustment	-	-5-8-6	+5+8+6	0
Total	214	242	0	456

	Total uses except exports	Exports	Total uses
Goods	250	196	446
Transport and insurance services	4 + 2	3+1	10
CIF/FOB adjustment	-	-	-
Total	256	200	456

European System of Accounts 1995

Supply table

	Output at basic prices	Imports	Total supply
Goods	196	250	446
Transport and insurance services	3+6+5+4	1+2	21
CIF/FOB adjustment	-	-5-6	-11
Total	214	242	456

Use table

	Total uses except exports	Exports	Total uses
Goods	250	196	446
Transport and insurance services	4+2	3+6+1+5	21
CIF/FOB adjustment	-	-5-6	-11
Total	256	200	456

Note: Data in the table are exclusively linked to imports and exports. Output at basic prices is equivalent to exports at basic prices.

The ESA 1995 suggestion is simpler, implying that only aggregated adjustments be used for imports and exports in order to guarantee a FOB/FOB evaluation of foreign trade. As shown in the SNA 1993 criterion, the net adjustment in each of the transactions would correspond to the value of services rendered by residents. Therefore, the ESA 1995 records only the following balance adjustment. Transport and insurance services on imports provided by resident producers (5 units) are globally deducted (see column for imports and row for the CIF/FOB adjustment). Transport and insurance services on imports provided by non-resident producers (8 units) are not recorded in the table. There is no adjustment column in the ESA procedure.

In the exports data, services rendered by resident units should be added. The result of these adjustments is that the value of the external balance will remain at the original level, since both imports and exports have been modified in the same way.

The choice of one or another of these alternatives depends on the balance between the necessary compliance with the accounting standards and practical reasons. Obviously, SNA 1993 is theoretically more correct in the sense that it permits an explicit FOB figure to be given for imports of goods. However, the ESA 1995 solution simplifies the tables and compilation processes in comparison to the SNA 1993 position.

4.4.3 Compilation problems

Goods

The main source of information is the customs statistics pertaining to the import and export of goods, with a very detailed breakdown by products. However, these statistics are an administrative register which usually collects all merchandise that crosses the border of a country, regardless of the type of transaction. Consequently, in order that this information complies with the ESA 1995 concepts, some adjustments will be necessary:

1) Merchandise that crosses the border without being imports.

   It will be necessary to reduce the amount of the following imported goods, if they appear in the basic information as goods in transit, goods for embassies, military bases or other enclaves within a country's borders, equipment or other goods coming from abroad for small repairs or maintenance or temporary functions such as exhibitions, operative renting, etc.

2) Merchandise that does not cross the border but are imports.

   Additions to the initial figures have to be made if they have not been stated from the outset for goods purchased by a country's embassies, military bases or other enclaves in other countries, goods produced by non-resident units that operate in international waters and that are sold directly to resident units (oil, fish, etc.), and supplies to resident means of transport by non-resident units.

3) Allowances and discounts that should be taken into account for the evaluation at basic prices if they are not already included in the customs figures.

4) Values collected through VAT. The INTRASTAT system considers a threshold from which it is compulsory to fill in the questionnaire. However VAT has to be paid on all transactions. If a check is made between that which has been declared as INTRASTAT and as VAT figures, the difference obtained corresponds to what has not been declared in INTRASTAT.

5) Goods which count as services. Customs statistics include a number of goods whose characteristics require their classification by products as services. For example: recorded computer supports which in the CPA belong to computer services; exposed (i.e. used, but undeveloped) films, which belong to photographic services, etc.

6) CIF-FOB valuation: Normally, customs statistics evaluate CIF (cost, insurance, freight) imports, which is the price of a commodity remitted to the importing country at the border. To pass the import of goods to the FOB evaluation, it is necessary to reduce these imports to the value of their freight (transport and insurance services of imported goods) between the borders of the exporting and the importing country.

Two different sources may be used for the compilation of imports of goods:

- Customs data (or similar ones: the INTRASTAT information in the EU).
- Survey information from firms which use imported goods.

Each of these sources have implications in terms of the methodological treatment of the CIF/FOB problem: In the first case, customs data records imports at the product group level at CIF value at the national border. Then the adjustment explained in section 3.2 should be applied, to reach a FOB aggregate value.

When data on buyers are used, only the purchasers' prices can usually be obtained. Therefore, the procedure is quite difficult, since additional adjustments have to be made. In any case, under certain circumstances proxies or substitute measures for the FOB value may be necessary, as ESA 1995 suggests:

- Barter of goods should be valued at the basic prices, that would have been received if the goods had been sold for cash.
- Transactions between affiliated enterprises: as a rule, actual transfer values should be used. However, if they differ markedly from market prices, they should be replaced by an estimated market price equivalent, or at least be separately identified for analytical purposes.
- Goods transferred under a financial lease: the goods should be valued on the basis of the purchasers' price paid by the lessor (not by the cumulative value of the rental payments).

Services

The evaluation of services imports is based on the balance of payments. The following adjustments should be introduced to this source:

- Freights (transport and insurance services) regarding the import of merchandise. They include transport and insurance services for goods imported by non-resident units up to the border of the exporting country when the goods are evaluated FOB.
- Freights (transport and insurance services) referred to the export of merchandise; they include transport and insurance services for goods exported by non-resident units up to the border of the exporting country when the goods are evaluated FOB.
- Goods which count as services. Customs statistics include a number of goods whose characteristics require their classification by products as services. For example, recorded computer supports which in the CPA belong to computer services; exposed (i.e. used but undeveloped) films, which belong to photographic services, etc., if they do not appear in the balance of payments.

Something similar occurs with direct purchases abroad by residents (and purchases on the domestic territory by non-residents): they are conventionally based on Balance of Payments data.

Final Remark: the EU market and its implications for statistical sources

Two factors will have a severe impact on the wealth of information on flows with the rest of the world for European countries for each of the two components of imports (and exports):

- The elimination of customs means losing the most important registration source of data which made it possible to estimate the flows of goods.
- The common currency also means the disappearance of the basic element used to assess services flows with the help of the balance of payments (those change of currency transactions were basic references).

Steps have already been taken towards the solution of both shortcomings. Regarding goods, the INTRASTAT system is the core of the future statistics on intra-community exchanges. Regarding the balance of payments, some countries have already started statistical research that will make up for the future lack of information.

The use table

chapter 5

5.1 Introduction

A use table shows the use of goods and services by product and by type of use for intermediate consumption by industry, final consumption expenditure, gross capital formation or exports. The use table also shows the components of gross value added by industry for compensation of employees, other taxes less subsidies on production, consumption of fixed capital, and net operating surplus.

The use table (Table 5.1) has two main objectives. Firstly, it reveals by column the input structure of each industry. Secondly, it describes in the rows the use of different products and primary inputs (labour and capital).

The costs of production are shown in the columns of the use table for each industry. The total output of an industry at basic prices corresponds to the total output of an industry as reported in the supply table. If the industry output is given and the intermediate consumption of products determined in the use table, value added of an industry can be estimated as a residual variable. However, if the main components of value added (compensation of employees, other net taxes on production, consumption of fixed capital) are given, net operating surplus is treated as the final residual variable. In the use table, total output and value added are recorded at basic price.

Table 5.1: Use table at purchasers' prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES (NACE)							FINAL USES									Total use at purchasers' prices
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU fob	Exportsextra EU fob	Total	
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	Intermediate consumption at purchasers' prices							Final demand at purchasers prices									
2	Products of industry																	
3	Construction work																	
4	Trade, hotel, transport services																	
5	Private services																	
6	Other services																	
7	Total																	
8	Cif/ fob adjustments on exports								Adjustment items									
9	Direct purchases abroad by residents																	
10	Domestic purchases. by non-residents																	
11	Total																	
12	Compensation of employees	Gross value added at basic prices																
13	Other net taxes on production																	
14	Consumption of fixed capital																	
15	Operating surplus, net																	
16	Gross Value added at basic prices																	
17	Output at basic prices																	

= empty

In the rows the use of each product for intermediate consumption and final use is shown. The intermediate consumption is shown by industry while final uses are broken down into final consumption expenditure, gross capital formation and exports. Final consumption expenditure is broken down to final consumption expenditure by households, final consumption expenditure by non-profit institutions serving households (NPISH) and final consumption expenditure by government. Gross capital formation contains separate columns for gross fixed capital formation, changes in valuables and changes in inventories. Exports of goods and services are reported in two separate columns for intra EU exports and extra EU exports. As all transactions of products are reported at purchasers' prices in the use table, the sum of each row is equal to the total use of a product at purchasers' price. For each product the total of use in the use table must be equal to the total of supply in the supply table.

The use table contains four important parts:

- Matrix of intermediate consumption at purchasers' prices
- Matrix of final demand at purchasers' prices
- Matrix of value added at basic prices
- Matrix of adjustment items

Table 5.2: Empirical example of a use table at purchasers' prices [5]

	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES (NACE)							FINAL USES									Total use at purchasers' prices
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU fob	Exportsextra EU fob	Total	
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	1 705	4 104	30	482	11	95	6 426	2 561		176	108		242	397	112	3 595	10 021
2	Products of industry	1 678	55 020	9 212	14 043	3 701	7 730	91 384	55 434		2 111	22 231	163	792	42 232	26 561	149 522	240 906
3	Construction work	99	542	1 993	950	3 695	1 445	8 724	1 032			20 761			429	280	22 501	31 225
4	Trade, hotel, transport services	83	4 420	401	11 129	1 321	1 493	18 847	26 586		328	67			3 285	2 223	32 488	51 334
5	Private services	171	7 400	1 732	10 490	21 810	4 618	46 221	22 156		195	4 254		- 24	3 606	2 345	32 533	78 754
6	Other services	102	1 323	77	813	1 682	3 052	7 049	9 507	3 670	36 988	251	61		187	90	50 753	57 802
7	Total	3 837	72 808	13 445	37 907	32 221	18 433	178 652	117 274	3 670	39 797	47 672	224	1 009	50 135	31 611	291 392	470 043
8	Cif/ fob adjustments on exports														- 133	- 30	- 163	- 163
9	Direct purchases abroad by residents								8 157								8 157	8 157
10	Domestic purchases. by non-residents								- 12 360						9 528	2 832		
11	Total	3 837	72 808	13 445	37 907	32 221	18 433	178 652	113 071	3 670	39 797	47 672	224	1 009	59 530	34 413	299 386	478 037
12	Compensation of employees	504	25 517	8 298	26 129	14 458	32 269	107 174										
13	Other net taxes on production	- 906	908	345	981	883	810	3 021										
14	Consumption of fixed capital	1 520	6 407	1 007	6 634	9 363	4 642	29 574										
15	Operating surplus, net	2 709	11 705	5 501	13 036	10 561	859	44 370										
16	Gross value added at basic prices	3 826	44 536	15 152	46 779	35 265	38 580	184 138										
17	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790										

Austria 2000

[5] All figures in this and the following tables are in millions of euros (m EUR) if no other dimension is specified

An empirical example of a use table is given in Table 5.2. The section on **intermediate uses** shows the intermediate consumption of products by industries which are required to produce their output. These purchases constitute the intermediate consumption of industries.

The section on **final uses** includes the values of the products absorbed by the various categories of final demand. All uses of goods and services – intermediate consumption and final uses – are valued at purchasers' prices. This price of a product is actually paid by the purchaser, excluding deductible VAT but including taxes less subsidies on products and trade and transport margins. In other words, the use table includes these taxes and margins in order to attain identities between supply and use at purchasers' prices.

The section on **value added** in the use table shows the costs of each industry in terms of factor costs for primary inputs, for example compensation of employees, other net taxes on production, consumption of fixed capital and net operating surplus. Other taxes less subsidies on production include production taxes paid by the industry or subsidies received by the industry excluding specific taxes on products such as VAT, petrol tax, tobacco tax and alcohol tax. For the supply and use system it is desirable to separate gross operating surplus into consumption of fixed capital and net operating surplus.

In the submission programme, supplementary information is requested by industry on fixed capital formation, capital stock, and labour inputs. This information allows calculation of labour and capital productivity and total factor productivity for each industry. For more information see Chapter 12 (Supplementary information and disaggregation of expenditure). Gross fixed capital formation in the use table may also be broken down by institutional sectors for the purpose of integrated institutional accounts.

For exports, the European System of Accounts adopts the price concept of 'free on board' prices (FOB). The FOB price is considered a particular purchasers' price which is typical for exports. In the official data submission programme for the European Union, the member countries are requested to separate exports into intra-EU exports and extra-EU exports. Further, a division of members of the euro area and non-members of this area is requested (for reasons of simplification, this regional distinction is not examined below).

In the use table three additional rows are introduced in order to make up for the differences that result from different valuation methods applied in the input-output framework. The additional rows are:

- CIF/FOB adjustments on exports
- Direct purchases abroad by residents
- Purchases on domestic territory by non-residents

In the supply and use system imports and exports are valued FOB. However, data on detailed flows of imports from foreign trade statistics are most usually valued at CIF prices. To reconcile the different valuations in use for total imports FOB and the imported products CIF, a global CIF/FOB adjustment row on imports is added to the supply table. The same negative entries are shown in the CIF/FOB adjustment row for exports.

In the supply and use system a territorial correction has to be made for direct purchases abroad by residents and purchases on the domestic territory by non-residents. This is because final consumption expenditure of households, as broken down by product, includes direct purchases of non-residents on domestic territory which have to be treated as exports. On the other hand, direct purchases of residents abroad have to be treated as imports and thus included in total final consumption expenditure of households.

The purchases of residents abroad are treated as both imports and final consumption expenditure of households. Thus an appropriate negative amount has to be entered in the imports column of the supply table and at the same time as negative entry in the column of final consumption expenditure of households in the use table.

Purchases on the domestic territory by non-residents are treated as exports and deducted from households' final consumption expenditure. Thus the corresponding amount is entered in the exports column with a positive value and deducted with the same amount in the column of final consumption expenditure of households. The balance of the row is zero.

For a balanced supply and use system it is of great importance that full-size valuation matrices are available on trade and transport margins and taxes less subsidies on products for the transformation of the supply table from basic prices into purchasers' prices. For the use table at purchasers' prices it is as important that the following three disaggregate matrices are compiled:

- Final consumption expenditure of households by purpose (COICOP)
- Final consumption expenditure by government (COFOG)
- Gross fixed capital formation by investing industries (Investment matrix)

Figure 5.1 demonstrates how final consumption expenditure by households is disaggregated by purpose according to the Classification of Individual Consumption by Purpose (COICOP). The same approach is implemented for final consumption expenditure by government. In this case the Classification of the Functions of Government (COFOG) is applied.

The calculation of capital stock data and the calculation of a valuation matrix for non-deductible value added tax (VAT) requires an assessment of gross fixed capital formation by product (producing industry) and investor (investing industry). For the European Union, the dimension of the investment matrix is 59 product and 59 investing industries. In the investment matrix, the user concept of capital – and not the owner concept of capital – should be reflected.

The assessment of consumption of fixed capital as a component of value added should be based on empirical capital stock data. In the European Union, the capital stock is derived from cumulative investment of the past based on the actual lifetime of a capital good with the perpetual investor method.

Figure 5.1: Disaggregation of the use table

	INDUSTRIES / PRODUCTS (CPA)	INPUT OF INDUSTRIES				FINAL USES									
		Agriculture	:	Other services	Total	Final consumption by households	Final consumption by non-profit institutions	Final consumption by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at purchasers' prices
No		1		59	60	61	62	63	64	65	66	67	68	69	70
1	Products of agriculture														
:	:														
59	Other services														
60	Total														
61	CIF/FOB adjustments exports														
62	Purchases abroad by residents														
63	Dom. purchases by non-residents														
64	Total														
65	Compensation of employees														
66	Other net taxes on production														
67	Consumption of fixed capital														
68	Operating surplus, net														
69	Value added at basic prices														
70	Output at basic prices														

Final consumption expenditure by households

	COICOP / PRODUCTS (CPA)	CLASSIFICATION OF INDIVUAL CONSUMPTION BY PURPOSE										
		Food, beverages and tobacco	Clothing and footwear	Housing, water, electricity	Furnishings, household equipment	Health	Transport	Leisure, entertainment and culture	Education	Hotels, cafes and restaurants	Miscallaneous goods and servces	Total
No		1	2	3	4	5	6	7	8	9	10	11
1	Products of agriculture											
:	:											
59	Other services											
60	Total											

Final consumption expenditutre by government

	COFOG / PRODUCTS (CPA)	CLASSIFICATION OF THE FUNCTIONS OF GOVERNMENT										
		General public service	Defence affairs and services	Public order and seafety affairs	Education affairs and services	Health affairs and services	Social security and welfare affairs	Housing and community amenity affairs	Recreational, cultural and religious affairs	:	Other economic affairs and services	Total
No		1	2	3	4	5	6	7	8		14	15
1	Products of agriculture											
:	:											
59	Other services											
60	Total											

Gross fixed capital formation

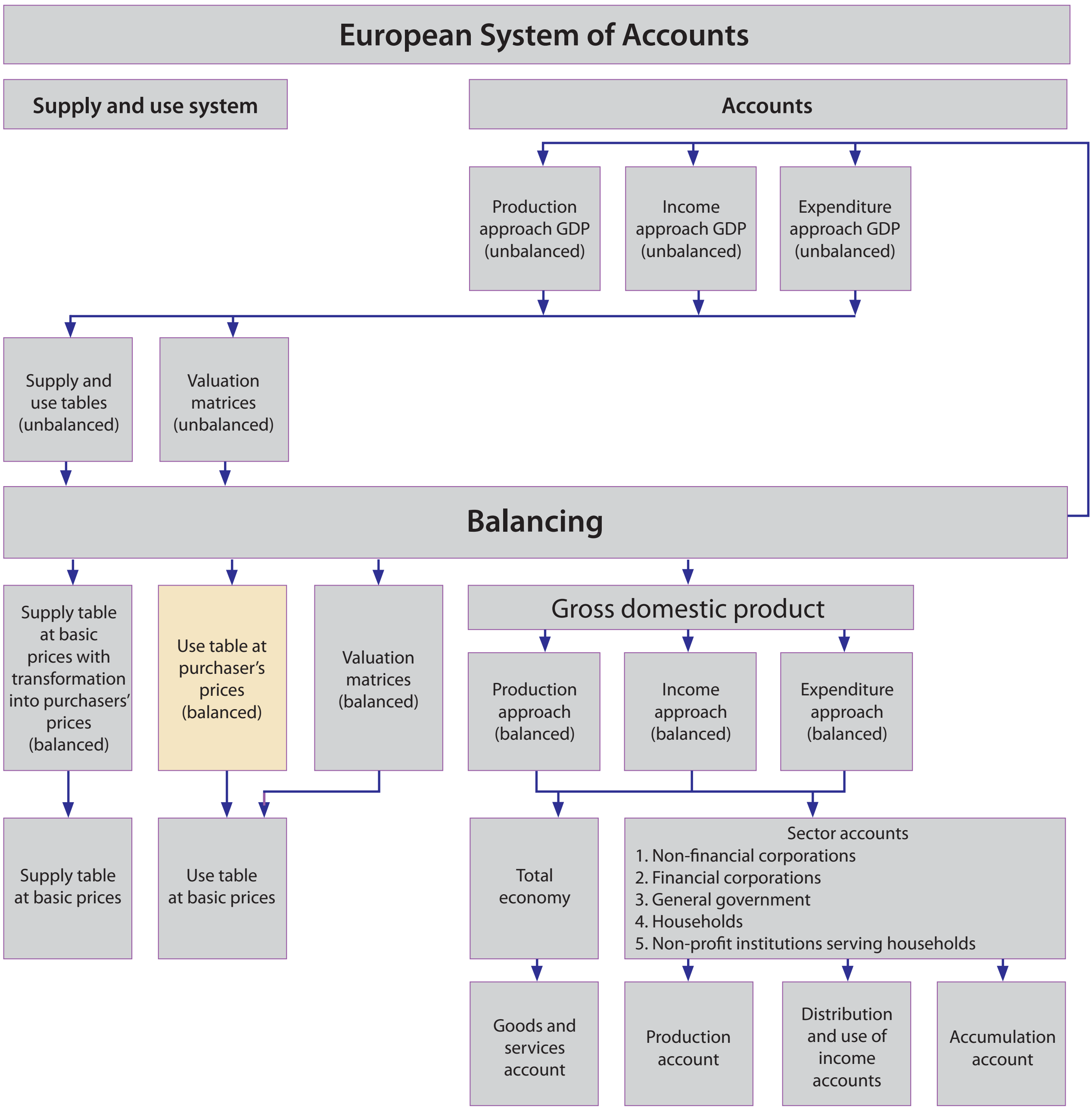
	INDUSTRIES (NACE) / PRODUCTS (CPA)	INVESTING INDUSTRIES										
		Agriculture, hunting	Forestry, logging	Fishing	Mining of coal and lignite	Extraction of crude oil and natura gas	Mining of uranium	Mining of metal ores	Other mining and quarrying	:	Private househlds	Total
No		1	2	3	4	5	6	7	8		59	60
1	Products of agriculture											
:	:											
59	Other services											
60	Total											

Consumption of fixed capital is calculated at current replacement cost of the net capital stock. The net capital stock is defined as the financial value of the gross capital stock still in use. It is obvious that it will be easier to estimate these three matrices on the basis of a rectangular supply and use system with many disaggregate homogeneous products.

5.2 Compilation of the use table

Figure 5.2 demonstrates how the use table is integrated into the European System of Accounts. The main macroeconomic variables of the alternative GDP calculation according to the production approach, namely the income approach and the expenditure approach, are fully reflected in the supply and use tables. At the same time, the supply and use system is fully compatible with the sector accounts. Supply and use tables constitute the ideal framework for balancing the national accounts.

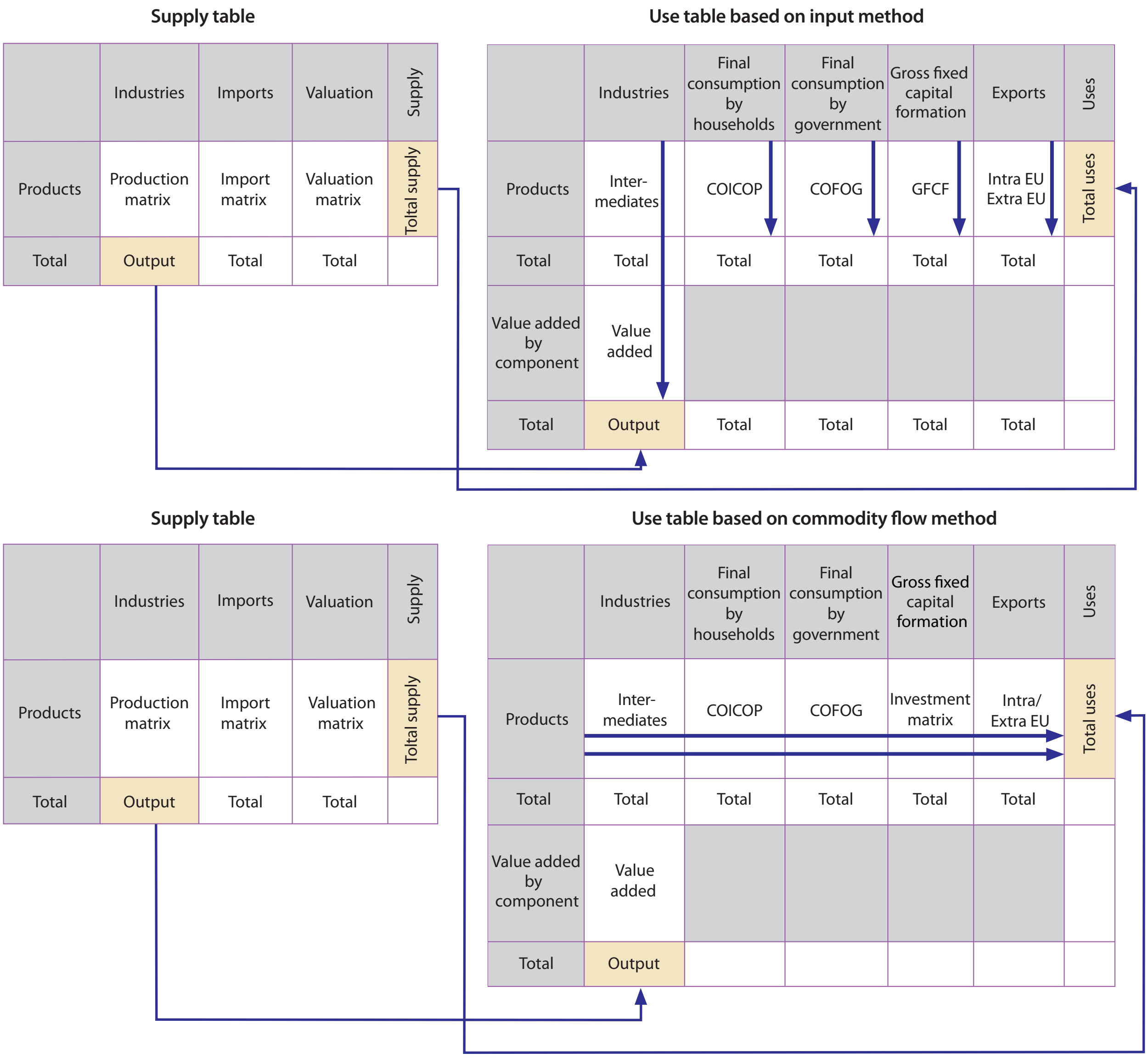
Figure 5.2: Compilation of the use table



Compiling the use table in practice depends a lot on the availability of detailed basic data for industries and categories of final demand. Therefore, the working procedures differ from country to country.

For compiling use tables two general options are available: the input approach and the output approach. In the input approach the cost structures of industries and input structures of final demand categories are compiled on the basis of specific survey results, while in the output approach the allocation of goods and services is determined with the commodity-flow methodology. As the input approach is based on collected data it is the recommended approach for populating the tables. The output approach is an alternative and can provide a cross-check. The two general approaches are presented in Figure 5.3.

Figure 5.3: Input and output methods



There is no absolute rule on deciding whether to give priority to columns or rows of a use table. It depends on basic surveys and specific country practices of national accounts. However, it is recommended to start the compilation process by column because data received from basic sources are fully reflected. At the same time this method is consistent with the institutional approach to identify the input structures for industries by intermediate consumption and value added and for the categories of final demand (consumption, gross capital formation, exports) by product. However, a distinction has to be made between population of the tables with a tendency by column and the balancing of the tales with a stronger row dimension.

The prime target of the use table is to identify the cost structures of industries and the input structure of final demand. The input approach can be implemented if survey results are available which identify the main cost structures. The main sources for the input approach are: Establishment Survey, Consumer Expenditure Survey, Government Expenditure Survey, and Capital Expenditure Survey. At the same time the use table identifies the use of products and primary inputs. The main sources of the output approach are: Production Statistics and Foreign Trade Statistics.

The output approach (Commodity-flow method) is highly dependent on survey results from production statistics and foreign trade statistics.

The commodity-flow method (output approach) is often used to compile use tables. It is a valuable complement of the input approach. The commodity-flow method facilitates identifying the output structure of goods and services. The more homogeneous goods and services are, the easier it will be to allocate the use in specific industries or categories of final demand. The commodity-flow method is widely applied for rectangular systems of products and industries in which the number of products is much larger than the number of industries. Provided that survey results are available, the input approach is the best option to identify cost structures. The commodity flow method is a valuable cross check for the input approach. It allows identifying a more refined structure of intermediate and final uses in terms of specific products. The commodity-flow method is also a powerful tool when it comes to balancing the system.

In absence of surveys on the cost structure of industries, the commodity flow method can be useful to compile the rows in a first stage even if later on they are changed during the balancing process. If commodity flows are compiled at a very detailed level, one will be able to break down intermediate consumption between industries even in the absence of complete and direct information on cost structures.

Nevertheless, the first stage is always to compile the totals of industries in terms of output, intermediates and value added. This is done in the production accounts of the system. Then the categories of final uses are added which were derived from specific surveys and statistics and commodity-flow accounts.

The following procedures will help to establish a fully integrated supply and use system for the national accounts:

- Production accounts
  Establish a set of production accounts with output, intermediates and value added by product with the input approach and the output approach.

- Trade and transport margins
  Calculate trade and transport margins for the production matrix.

- Other taxes less subsides on products
  Calculate other taxes less subsidies on products for the supply table. Other taxes on products do not include non-deductible value added tax (VAT).

- Final uses
  Add the categories of final uses derived with the commodity-flow method to the use table.

- Non-deductible value added tax
  Calculate a matrix of non-deductible VAT for the use table. It can only be compiled from the use side of the supply and use system.

- Balance the supply and use tables with the input approach and the commodity flow method.

The use table of the system gives information on the uses of goods and services and primary inputs but also on the cost structures of the industries.

5.2.1 The input approach

The column approach

The main sources for industry output estimates are production surveys and surveys of enterprises. These give rather detailed information on products sold. An example for a questionnaire of an establishment survey is given in Box 5.1. Based on a business register or establishment census a sample should be drawn to conduct an annual establishment survey. The establishment survey should enquire the main and secondary activities of the establishment. It also should cover information on employment, output, intermediates and value added. It will be the major source for estimating the cost structures of industries by product and component of value added. It also explores the fixed and financial assets and liabilities and the categories of gross fixed capital formation.

Many nations conduct special cost structure surveys for each industry. They are a very important source for compiling output, intermediates and value added by industry for the national accounts with the production approach.

Box 5.1: Annual economic survey of establishments 2005

I. Economic activity

Main economic activity of the establishment in detail:

____

Secondary activity:

____

II. Total number of employees during the year 2005

Average number of employees	
	Total
Male	
Female	
Total	

III. Compensations of employees during the year 2005 (in thousands of Euro)

Item	Total
1. Wages and salaries	
2. Fringe benefits	
3. Social insurance and retirement payments	
4. Insurance installment for accident at work	
5. Reward of boards	
6. End of service bonus fund	
Total	

IV. Operating expenditures during the year 2005 (in thousands of Euro)

Item	Value	Item	Value
1. Stationary		14. Studies and research expenses	
2. Consumption of electricity		15. Other services offered by others	
3. Consumption of water		16. Training, conference and travel expenditures	
4. Consumption of fuel and oil		17. Printing services	
5. Telegraph, mail and telephone		18. Usable raw materials	
6. Spare parts and tools		19. Payments for subcontractors	
7. Maintenance services		20. Packing materials	
8. Banking services fees		21. Usable cleaning materials	
9. Advertising		22. Other operating expenditures:	
10. Rent of buildings and lands		a)	
11. Rent of equipment and machines		b)	
12. Marketing expenditures		c)	
13. Consultations and accounts auditing expenses		d)	
Total operating expenditures		→	

V. Non-operating expenditures during the year 2005 (in thousands of Euro)

Item	Value	Item	Value
1. Indirect fees and taxes		10. Reward of end of work paid	
2. Passive debts		11. Income and profit taxes	
3. Expenses of previous years		12. Allotted debts doubtful to be repaid	
4. Selling losses of capital assets*		13. Losses of selling raw materials*	
5. Insurance installments		14. Other (to be clarified):	
6. Rent of agricultural lands		a)	
7. Payable or interests due		b)	
8. Compensations and payable penalties		c)	
9. Distributed profits (lots, shares and sharing)		d)	
Total of non-operating expenditures		→	

* Difference between the book value and the cost of selling the asset.

VI. Goods purchased for resale purpose during the year 2000 (in thousands of Euro)

Purchases	Sales

(continued)

VII. Operating revenues during the year 2005

Item	Value	Item	Value
1. Revenues from main economic activity		4. Rent from equipment and machines	
2. Revenues from secondary activities		5. Revenues from side products	
3. Rent from buildings and lands		6. Other services provided to others	
Total operating revenues		→	

VIII. Non-Operating revenues during the year 2005

Item	Value	Item	Value
1. Interests collected or due		9. Profits from selling raw materials*	
2. Compensation collected from insurance		10. Government subsidies	
3. Compensation and penalties collected or due		11. Donations	
4. Passive debts collected		12. Profits of selling banknotes	
5. Revenues of previous years		13. Other non-operating revenues:	
6. Profits from selling capital assets*		a)	
7. Profits from lots, shares and sharing		b)	
8. Rent from agricultural land		c)	
Total operating revenues		→	

* Difference between the book value and the cost of selling the asset.

IX. Inventory during the year 2005 (in thousands of Euro)

Item	Beginning of the year	End of the year
1. Purchased goods for purpose of reselling		
2. Primary materials		
3. Completed products, under production products		

X. Changes in assets and liabilities during the year 2005 (in thousands Euro)

Fixed and financial assets

(a) Fixed assets *	Value of assets at the beginning of the year	Annual depreciation	Assets purchased during the year (additions)	Assets sold during the year (exclusions)	Value of assets at the end of he year
1. Residential buildings					
2. Non Residential buildings and structures					
3. Means of transportation					
4. Machines & equipment					
5. Furniture					
6. Land					
7. Other fixed assets					
Total					

* Net value at the year end = Net value at the year beginning – annual depreciation + additions – exclusions.

(b) Financial assets	Value at the beginning of 2005	Value at end of 2005
1. Cash deposits and balances in the fund or with others		
2. Banknotes except shares		
3. Loans (include debtors)		
4. Lots, shares and sharing		
5. Other accounts with loan fee		
Total		

Financial liabilities

Item	Value at the beginning of 2005	Value at end of 2005
1. Cash deposits and balances		
2. Banknotes except shares (bills, deeds, etc.)		
3. Loans (include debtors)		
4. Lots, shares (rights of shareholders)		
5. Other accounts with the payment of a fee		
Total *		

* Total of financial liabilities = inventory + total fixed assets + total financial assets (at beginning and end of the year).

Name of data provider:	Telephone No.:

Data by industry

Output, value added and intermediate purchase of industries are ascertained using annual enterprise surveys or fiscal data. The compilation of industry output and product output is an important task in the construction of the use and supply tables. Though the number of industries and products in the final supply and use tables may be no larger than 100, the initial number of industries for which outputs are prepared and the number of goods and services (or products) are normally much larger and should be as large as information allows.

For instance, within a given industry with few sub-sectors out of which the output of only one sub-sector is significant in comparison with the other sub-sectors, we may try our best to obtain information on the input structure of the most significant sub-sector and be satisfied with some rough approximation for other insignificant sub-sectors if we do not have financial resources to survey input structures of all sub-sectors.

Products purchased by households

Data on household consumption may be derived from household budget surveys. Information from household budget surveys should be cross-checked with information from retail sales and other sources. The household budget survey is a survey of a representative random sample of all private households in a nation. The main purpose of the survey is to compile final consumption expenditure of households. The results are also used to determine in detail the current pattern of household expenditure in order to update the weighting basis of the Consumer Price Index. Detailed information is also collected on all sources of household income and on a range of household facilities.

The data content of the Household Budget Survey is based on national and international recommendations and classifications. Household Budget Surveys are conducted in all EU Member States. Eurostat harmonises the concepts, definitions and classifications of the Household Budget Surveys and releases comparative data on the Household Budget Surveys of the Member States.

Investment by industries and by products

Investment by enterprises is derived from enterprise surveys. They provide information by economic sectors, and sometimes by main products (transport equipment, machinery, building, software) but not in great detail, making it easier to derive investment by institutional sector than by products.

Exports by product

Information on foreign trade of goods according to international regulation is available in great detail, but less reliable than in the past because of the development of the European single market. International trade of services is an area in which statistics are rapidly developing. Intrastat, international trade in services surveys and international passenger surveys will help to compile exports and imports of services.

5.2.2 The output approach

The row approach

The output approach is identical with the commodity-flow method. The identity between resources and uses of products requires that commodity flows by products can actually be compiled. The commodity flow methods as a general approach to national accounting is more developed in countries in which information of the input structure of industries is missing. It is considered a good procedure to compile value added for the economy as a residual variable of output less intermediate consumption. In general, it can be said that the commodity flow method is a valid procedure for rectangular systems which include many more homogeneous products than industries.

Commodity-flow method

Compiling detailed flows of goods and services is traditionally referred to as the commodity-flow method, utilising basic statistics on goods and services with the additional items required for the proper valuation. The full power of the commodity-flow method is reached when independent estimates could be made for each of the use items. In other words, the results of the commodity-flow method have to be verified by the main findings of the input method.

If the commodity-flow method is applied, a reconciliation of the supply and use side of commodities is necessary. In come cases, the commodity-flow method is less sophisticated, when one of the uses has to be derived as a residual variable. Alternatively, the uses are distributed in fixed proportions.

The aim of the method is to trace across each row of the use table the consumption of every product by industries in intermediate use and by various institutional sectors as final use. The elaboration of uses for each homogeneous product provides a powerful method to fill in the use table along each row.

To implement the commodity-flow method it is recommended to establish as a first step, a supply table at producers' prices (Figure 5.4). This strategy has been implemented by Statistics Norway (Simpson 2005a). Producers' prices are not any longer an official valuation concept in SNA 1993 and ESA 1995. However, survey results indicate that it is easier to collect information from enterprises at producers' prices than at basic prices. In a second step taxes on products (excluding VAT) and subsidies on products are allocated to products and distributed between domestic suppliers and import of the products. Finally, the supply table at basic prices is calculated by deducting taxes less subsidies on products excluding VAT from supply at producers' prices.

The supply table at basic prices gives detailed information about the supply of products. The production accounts of the supply table include the following produvers:

- Own final use
- Market producers
- Non-market producers

The use table gives information on intermediate uses of products by industries and final uses of products, specifying domestic final use and exports. The use table at purchasers' prices is decomposed into the different valuation matrices. They contain taxes less subsidies on products excluding VAT, trade and transport margins and non-deducible VAT.

The first phase of balancing of supply and use begins at producers' prices, the change in inventories is determined as a residual variable. In a manual procedure the residuals are then corrected to an acceptable level. In a second step trade and transport margins and the non-deductible VAT are compiled with the commodity-flow method on the use side. The final result of this compilation is the use table at purchasers' prices.

A valid option is to start with establishing the use table at purchasers' prices then apply trade and transport margin rates to form the valuation layers, compile taxes and subsidies on products distributed among the domestic uses and calculate the use table at basic prices by deducting net taxes and margins from purchasers' value. Finally, changes in inventories are calculated with the commodity flow method as the difference between supply and use of each product. In this case the various valuation layers have to be deducted from purchasers' prices to arrive at uses at basic prices.

Figure 5.4: Data base for commodity-flow method

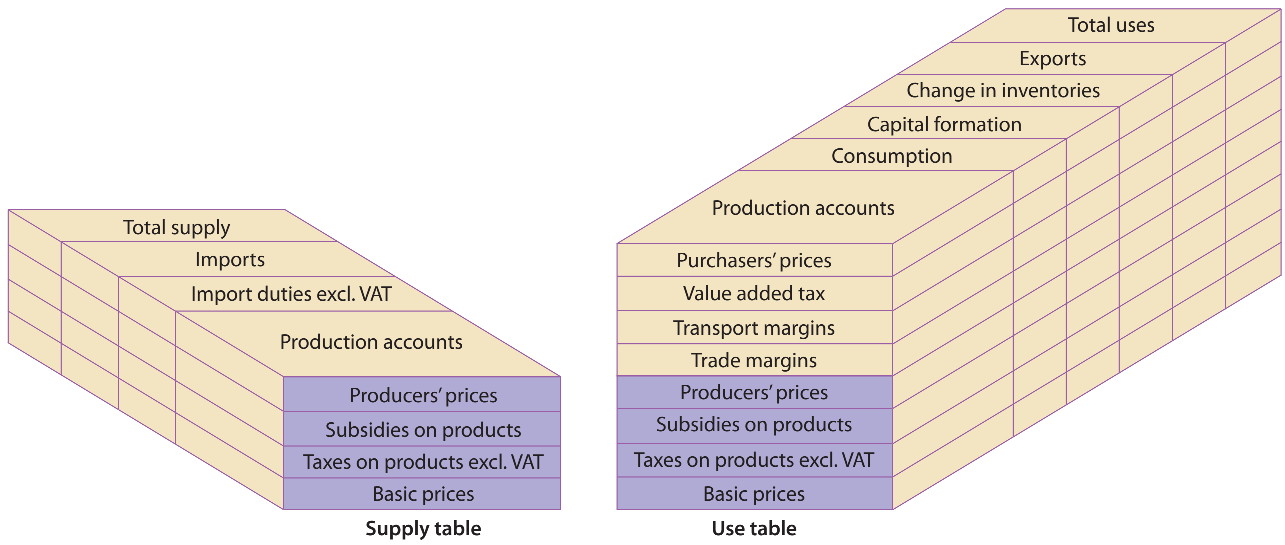


Table 5.3: Commodity-flow method for selected products

No	Code	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES: Agriculture	Mining	Industry	Private services	Other services	Total	FINAL USES: Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exportsextra EU FOB	Total	Total use at purchasers' prices
			1	2	…	58	59	60	61	62	63	64	65	66	67	68	69	70
		A. PRODUCTS OF AGRICULTURE, FORESTRY AND FISHING																
1	11111	Durum wheat																
204	30072	Support services to aquaculture																
		B. MINING AND QUARRYING																
205	51010	Hard coal																
241	99019	Support services to other mining and quarrying n.e.c.																
		C. MANUFACTURED PRODUCTS																
242	101111	Meat of bovine animals, fresh or chilled																
1987	332070	Installation services of other goods n.e.c.																
		D. ELECTRICITY, GAS, STEAM AND AIR CONDITIONING																
1988	351110	Electricity																
1998	353022	Cooled air and chilled water supply services																
		E. WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION SERVICES																
1999	360011	Drinking water																
2070	390023	Other specialised pollution control services																
		F. CONSTRUCTIONS AND CONSTRUCTION WORKS																
2071	410010	Residential buildings																
2131	439990	Specialised construction works n.e.c.																
		G. WHOLESALE AND RETAIL TRADE SERVICES; REPAIR SERVICES OF MOTOR VEHICLES AND MOTORCYCLES																
2132	451111	Wholesale trade services of passenger motor vehicles																
2367	470099	Retail trade services of other second-hand goods																
		H. TRANSPORTATION AND STORAGE SERVICES																
2368	491011	Passenger rail transport services for sightseeing																
2483	532019	Other postal and courier services n.e.c.																
		I. ACCOMMODATION AND FOOD SERVICES																
2484	551010	Room or unit accommodation services for visitors, with daily housekeeping (except time-share)																
2503	563010	Beverage serving services																
		J. INFORMATION AND COMMUNICATION SERVICES																
2504	581111	Printed educational textbooks																
2642	639920	Original compilations of facts/information																

		K. FINANCIAL AND INSURANCE SERVICES
2643	641110	Central banking services
2722	663012	Pension funds management services
		L. REAL ESTATE SERVICES
2723	681011	Residential buildings and associated land sales or purchases services
2738	683213	Non-residential property management services on a fee or contract basis
		M. PROFESSIONAL, SCIENTIFIC AND TECHNICAL SERVICES
2739	691011	Legal advisory and representation services concerning criminal law
2951	829919	Other miscellaneous business support services n.e.c.
		N. ADMINISTRATIVE AND SUPPORT SERVICES
2865	771110	Rental and leasing services of cars and light motor vehicles
2951	829919	Other miscellaneous business support services n.e.c.
		O. PUBLIC ADMINISTRATION AND DEFENCE SERVICES; COMPULSORY SOCIAL SECURITY SERVICES
2952	841111	Executive and legislative services
2985	843014	Compulsory social security services concerning family and child allowances
		P. EDUCATION SERVICES
2986	851010	Pre-primary education services
3018	856010	Educational support services
		Q. HUMAN HEALTH AND SOCIAL WORK SERVICES
3019	861011	Hospital surgical services
3059	889919	Other social services without accommodation n.e.c.
		R. ARTS, ENTERTAINMENT AND RECREATION SERVICES
3060	900110	Services of performing artists
3094	932929	Entertainment services n.e.c.
		S. OTHER SERVICES
3095	941110	Services furnished by business and employers membership organisations
3138	960919	Other miscellaneous services n.e.c.
		T. SERVICES OF HOUSEHOLDS AS EMPLOYERS; UNDIFFERENTIATED GOODS AND SERVICES PRODUCED BY HOUSEHOLDS FOR OWN USE
3139	970010	Services of households as employers of domestic personnel
3141	982010	Undifferentiated services produced by private households for own use
		U. SERVICES PROVIDED BY EXTRATERRITORIAL ORGANISATIONS AND BODIES
3142	990010	Services provided by extra-territorial organisations and bodies
		Total

= Actual transactions

Box 5.2: Numerical example of the compilation of a commodity flow in practise

In this example, a commodity flow of a product and the production account of the corresponding industry are compiled. The product is steel, and the values are given in millions of euros (m EUR). It is assumed that the steel output is produced by local kind of activity units which have two secondary productions and a by-product:

- Electricity (by use of the blast furnace gas): a large part is sold on the market and a small part is consumed by local kind of activity units of the steel industry (inter-establishment deliveries not sold).
- Products of construction: these units perform large maintenance and repair works on their installations themselves.
- Dross results as a by-product from the production of steel.

From enterprise economic surveys and production surveys, we have the following information:

Quantities:

- Output: steel (11 m tons), dross (2 m tons), gas (500 m m^3), electricity (2000 million kWh).
- Changes in inventories: steel (+1 m tons), dross (+0.1 m tons).

Values (in m EUR)

- Turnover: steel (9500 including 100 of taxes on product), dross (38), electricity (160).
- Purchases on intermediate consumption (6500)
- Changes in inventories (-500)

By way of supplementary "ad hoc" calculations, it is possible to estimate

- Value of the part of electricity which is produced and not sold as inter-deliveries (40)
- Value of own-account production in construction to be treated as GFCF expenditure (350)

We assume here that we do not know changes in inventories of steel in value at the producers, so it must be estimated by multiplying the change in inventory of producers (1 ton) by the average price of steel (9500 €/10 = 950 € per ton. Furthermore, imports of steel are 1200 (CIF) and exports (FOB) of steel are 2000. Concerning imports, for the sake of simplicity, we take the value of transport between borders to be 30, 10 of which are rendered by residents and 20 by non residents.

From surveys, we know that half of the steel sold on the domestic market is distributed though the wholesale trade industry whose margins represent 20 % of the basic price of steel. The other part is directly sold from producers to users. Exported products are also sold directly by producers. Transport margins, i.e. transport directly paid by purchasers, are estimated to be 100.

A survey on users of steel indicates a change in their inventories of 600.

The rate of VAT on the steel products is 20 % of the price excluding VAT. Institutional units subject to the VAT system can deduct VAT from their purchases. Purchases of steel products by units which are not subject to the VAT system amount to 480 (this amount thus includes VAT). There is no tax, other than VAT, on imports.

Supply

From this information it is possible to compile the commodity flow of steel.

a) Output at basic price = turnover + changes in inventories - taxes on products included in turnover
10350 = 9500 + 950 - 100
b) Imports and Import duties with Imports = 1200 € and Import duties = 0
c) Trade margins
Calculation of value of steel sold on the domestic market (excluding margins)
Turnover (9500) + imports (1200) - exports (2000) = total (8700)
Trade margins 10% = 870
d) Transport margins = 100
e) VAT on products and taxes on products

The amount of purchases of steel by producing units not subject to the VAT system is equal to 480 (this amount already includes VAT). The rate of VAT applicable to steel (on the prices excluding VAT) being 20 %, VAT amounts to 80 (= 480 * 0,2 /1,2). We must also add the amount of taxes on products to the value of supply at purchasers' price (100).

Box 5.2: Numerical example of the compilation of a commodity flow in practise *(continued)*

Total supply of steel product (at purchasers' price) = output at basic price + VAT + other taxes on products + imports + trade margins + transport margins)
12700 = 10350 + 80 + 100 + 1200 + 870 +100

Uses

f) Exports = 2000
g) Changes in inventories: at producers = 950 € and at users = 600 €
h) If we assume that total supply equals total uses, we can deduct the total of intermediate consumption:
12700 - 2000 - 950 - 600 = 9150 (total supply – exports – changes in inventories)

In practice, from one year to another, we could also balance on trade margins or changes in inventories if we have information about the change in intermediate consumption of steel.

i) Moreover, when we compile the input-output table for the whole economy, we have to make the CIF-FOB adjustments.
j) Finally, we compile the production accounts of steel industry:

Output is equal to (10350+38+160+40+350 = 10938) of which 38 is the value of dross, 160 corresponds to the sales of electricity, 40 is electricity produced but not sold (inter-deliveries), 350 is the output of construction for own final use.

Intermediate consumption is equal to purchases plus electricity produced and consumed without sales (40), plus changes in inventories (6500 + 40 - 500 = 6040) so that value added of steel industry is equal to 4898 (=10938 - 6040).

SUPPLY TABLE

	INDUSTRIES / PRODUCTS	Total output at basic prices	Imports CIF	Total supply at basic prices	VALUATION				Total supply at purchasers' prices
					Trade margins	Transport margins	VAT	Other net taxes on products	
No		1	2	3	4	5	6	7	8
1	Steel	10 350	1 200	11 550	870	100	80	100	12 700
2	Dross	38							
3	Gas								
4	Electricity	200							
5	Construction	350							
6	Other								
7	Output at basic prices	10 938							

USE TABLE

	INDUSTRIES / PRODUCTS	INPUT OF INDUSTRIES		FINAL USES					Total use at purchasers' prices
		Steel	Total intermediates	Cnsumption	Gross fixed capital formation	Change in inventories	Exports	Total	
No		1	2	3	4	5	6	7	8
1	Steel		9 150			1 550	2 000	3 550	12 700
2	Dross								
3	Gas								
4	Electricity								
5	Construction								
6	Other								
7	Total	6 040							
8	Value added	4 898							
9	Output at basic prices	10 938							

Table 5.3 demonstrates for selected products which allocation of uses is expected. Electricity is expected to be used in all industries and in selected categories of final uses such as consumption and exports. On the other hand, residential buildings are only allocated to gross fixed capital formation as they can not be used as intermediates or be exported to other countries.

The consumption of a product as intermediate inputs is determined by three factors: (i) input of industries which require the product as input for production, (ii) outputs of the industries that sell the product to other industries and (iii) the intrasectoral requirements of an industry of its own product.

The commodity flow approach gives a clear advantage in identifying the many flows of products. For many products, by their nature, it is possible to identify whether they are used as intermediates or as capital goods and often even where they are used. For example, tractors are capital goods that are used in agricultural industries. When compiling commodity flows at a very detailed level, it is thus often possible to allocate the supply of a particular product to only one domestic use: intermediate consumption of a well-defined industry or final use in consumption or gross fixed capital formation. For example, one can accept that the output of the machinery for paper is consumed by papers industries. Therefore, some countries compile commodity flows by product according to a more detailed classification than that of the industries: for instance, France (472 products), Netherlands (326 products), Norway (1750 products), Denmark (2700 products). The Central Product Classification (CPC) identifies 3142 products.

Ideally, all of the components of the equation between supply and use could be estimated separately. But, in practice, this is impossible due to a lack of information.

The commodity flow method is less sophisticated when one of the uses must be estimated as a balancing item, or when the breakdown between users must be estimated using some fixed proportions. Often some data are very well known and can be elaborated in the detailed classification, e.g. imports, exports, taxes and subsidies, and products, and sometimes final consumption expenditure. In practice, intermediate consumption is often calculated as a balancing item if there is no gross capital formation involved (see Box 5.2). On the other hand, if capital formation is affected, it is possible to make a first split between capital formation and intermediate consumption, and to refine it during the general balancing process.

The supply and use tables provide an accounting framework within which the commodity flow method of compiling national accounts can be systematically exploited. The main benefit of the tables is that the total supplies and uses of individual goods and services have to be balanced with each other.

The central supply and use tables integrate various approaches. They integrate the calculation of GDP by industry (vertical approach) and the commodity-flow approach (horizontal approach). If it is difficult to break down intermediate inputs by product, a commodity flow approach may be followed. This permits the balancing of supply and use to be undertaken on a regular annual basis, even when intermediate consumption can not be analyzed with the same frequency for each industry according to its cost structure.

5.2.3 Compilation of uses by categories

In the following section, the appropriate allocation of various categories of intermediate and final uses is discussed.

Intermediate consumption and gross fixed capital formation

Ordinary maintenance and repair expenditures are treated as intermediate consumption, whereas major renovations or enlargements to fixed assets (capital repairs) are treated as GFCF. 'Research and development' is considered as intermediate consumption and includes expenditures for one's own account.

Intermediate consumption and households final consumption expenditure

The most difficult case refers to expenditures incurred by unincorporated enterprises belonging to households: these have to be separated between intermediate consumption of enterprises and the final consumption of their owners. This is the case, for example, for energy products consumed by farmers. It is then necessary to make specific investigations in order to make this breakdown.

Business tourism (by wage and salary earners of institutional units) is also an issue. Normally, it is included in intermediate consumption in hotels/cafés/restaurants products rather than in household final consumption. It is difficult, nevertheless, to split travel expenditures between those made for recreational purposes and those for business purposes.

In the renting industry, as far as actual renting is concerned, a distinction should be made between current expenditures which are usually payable by owners, to be treated as intermediate consumption, and those which are incurred by tenants, which constitute final consumption. For instance, ordinary maintenance of dwellings is the intermediate consumption of owners. On the other hand, expenditures for heating, electricity made by tenants are final consumption expenditures of households. In the case of owner-occupied dwellings, the same kind of distinction has to be made, where possible.

Household final consumption expenditure and exports

The main issue here deals with purchases made by non-residents on domestic territory and purchases made by residents abroad. Most of these purchases are recorded under 'Travel' in the Balance of Payments.

For instance, the HCR's 'product commodity flow' records final consumption on the domestic territory by resident households as well as by non-resident ones. To assess 'national' final consumption expenditure, it is necessary to subtract consumption by non-residents (which is added to exports) and to add purchases of goods and services supplied abroad to residents. The balance is subtracted from the apparent household consumption on domestic territory: this is made in the 'territorial correction' row. However some countries have surveys on resident households, allowing a direct estimate of residents' final consumption.

Household final consumption expenditures and gross fixed capital formation

This primarily concerns the purchases of durable goods made by households owning unincorporated enterprises.

5.2.4 Some accounting conventions

For a proper compilation and understanding of the use table (as is also the case for the supply table), it is important to recall some of the accounting conventions used in ESA 1995.

Treatment of financial and operating leasing

Capital goods may be subject to operating leasing as well as financial leasing. In the case of operating leasing, their acquisition is recorded in the fixed capital formation and the fixed capital stock of their legal owner, i.e. the business which provides the operating leasing. Accordingly, rentals are recorded as intermediate consumption of their users.

In the case of financial leasing, their acquisition is recorded in the fixed capital formation and the fixed capital stock of their legal user. There is no intermediate consumption in respect of any rental (only FISIM should be recorded in this respect if allocated).

Staff working via temporary agencies

These staff members are recorded as being employed in the industry of these agencies, and not in the industries in which they are actually working. As a consequence, in the latter industries, payments relating to these staff are recorded as intermediate consumption and not as compensation of employees. Labour contracted out is treated likewise.

Treatment of second-hand goods

The transfer of existing goods is recorded in the use table as a negative expenditure for the seller and a positive expenditure for the purchaser. For the product group involved, the transfer of an existing good amounts to a reclassification among uses. Only the transaction costs are not a reclassification: they are recorded as a use of business or professional services. For the purposes of description and analysis, it can be useful to show, for some product groups, the relative size of the transfer of existing goods separately, e.g. the importance of second-hand cars or the importance of recycled paper.

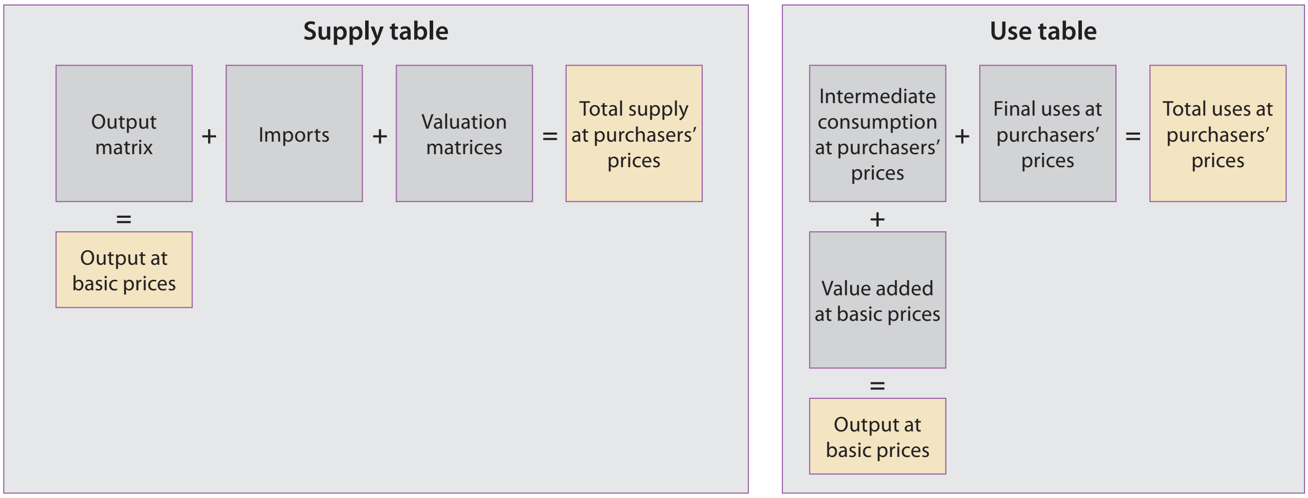
Treatment of cross-border repair and installations

Manufactured goods, in particular capital goods, which are sent abroad to be repaired are not entered in imports and exports. However, the repair service is recorded as an import of services.

5.3 Institutional sectors, industries and homogeneous production units

Between supply and use tables, two types of identities hold. In Figure 5.5 the column totals of industries in the supply and use tables (output at basic prices) are equal. At the same time, the row totals for products of the supply and use table (supply and uses at purchasers' prices) are equal. The balancing process should not be limited to the supply and use tables at current prices. Compiling supply and use tables at current and constant prices for two or more years will help to balance the changes in volumes, values, and prices. Compared to the balancing of supply and use tables for a single year, the compilation of a longer time series will improve the effectiveness of the input-output framework for the integration and balancing of the European System of Accounts.

Figure 5.5: Supply and use tables



The compilation of the use table is always linked with the compilation of the supply table. Provided supplies and uses are valued consistently, two types of identities hold between supply and uses tables:

- **Supply and demand**
  For each product the identity is given that supply equals demand. In the supply and use system, the total of each row in the supply table is equal to the corresponding row total in the use table. Total supply by product at purchasers' prices = Total use by product at purchasers' prices

- **Input and output**
  For each industry the output is equal to its inputs. The column total of each column in the supply table equals the corresponding column total in the use table. Total output by industry at basic prices = Total intermediate consumption at purchasers' prices + value added by industry.

In the use table, output is shown by industry. ESA 1995 recommends the retention of the 'local kind of activity unit' (local KAU) for this analysis. The group of all local KAUs engaged on the same, or similar, kind-of-activity constitutes an industry.

The classification used for industries is the NACE, with the CPA used for the classification of products. These two classifications are fully aligned to each other: at each level of aggregation, the CPA shows the principal products of the industries according to the NACE.

In the supply and use tables, the classification for products is at least as detailed as the classification for industries, e.g. the three digit-level of the CPA and the two digit-level of the NACE. An adaptation of these two classifications must necessarily be made in each country, to adapt to local specificity of the output and final uses. In the submission programme for the European Union, 59 products (CPA) and 59 industries (NACE) are mandatory for supply and use tables.

This chapter demonstrates for a small numerical example how a normal supply-and-use system can be established based on the principles of SNA 1993 and ESA 1995. In Table 5.4 the supply table is derived from the institutional sector accounts. The 'Local kind of activity units' are disaggregated to industries with homogenous units of production.

In the example, five industries and five products are included: Agriculture, Industry, Trade, Business services, and Other service activities.

Table 5.4: Example for institutional sectors, industries and homogeneous production units

INDUSTRIES / PRODUCTS	Industries with homogeneous units of production						Industries (local KAU)					
	Agriculture	Industry	Trade	Business services	Other services activities	Total	Agriculture	Industry	Trade	Business services	Other services activities	Total
Non-financial corporation 1												
Products of agriculture	60					60	58					58
Manufactured products		110				110	1	110				111
Trade												
Business services				50		50	1			50		51
Other services activities												
Total	60	110		50		220	60	110		50		220
Non-financial corporation 2												
Products of agriculture								3				3
Manufactured products		91				91		88		1		89
Trade												
Business services				20		20				19		19
Other services activities												
Total		91		20		111		91		20		111
Non-financial corporation 3												
Products of agriculture												
Manufactured products												
Trade			39			39			39			39
Business services												
Other services activities												
Total			39			39			39			39
Government sector												
Products of agriculture												
Manufactured products												
Trade												
Business services											2	2
Other services activities					16	16					14	14
Total					16	16					16	16
Household sector												
Products of agriculture	40					40	40					40
Manufactured products												
Trade												
Business services												
Other services activities												
Total	40					40	40					40
Supply table												
Products of agriculture	100					100	98	3				101
Manufactured products		201				201	1	198		1		200
Trade			39			39			39			39
Business services				70		70	1			69	2	72
Other services activities					16	16					14	14
Total	100	201	39	70	16	426	100	201	39	70	16	426

There are trade and transport margins on products of agriculture and manufactured products. We assume that the output of trade and transport is not exactly equal to the total of trade and transport margins for agricultural and manufactured products, as maintenance and repair services (motor vehicles for instance) and intermediate consumption items in transport (subcontracting, warehousing, parking, business tourism, etc.) are also included.

Table 5.5 gives the fictitious example of Table 5.4 presented with three institutional units belonging to the sector of non-financial corporations, one institutional unit belonging to the general government sector and one institutional unit belonging to the sector of households. The institutional unit 1 belonging to the sector of non-financial corporations is partitioned into 3 local kind-of-activity units with the principal activities of agriculture (60), industry (110) and private services (50).

Table 5.5: Numerical example for supply and use tables

Supply table at basic prices, including a transformation into purchasers' prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)								VALUATION		
		Agriculture	Industry	Trade services	Private services	Other services	Total	Imports cif	Total supply at basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11
1	Products of agriculture	98	3	0	0	0	101	20	121	12	1	134
2	Manufactured products	1	198	0	1	0	200	40	240	14	3	257
3	Trade	0	0	39	0	0	39	0	39	- 26	0	13
4	Private services	1	0	0	69	2	72	15	87	0	18	105
5	Other services	0	0	0	0	14	14	0	14	0	0	14
6	Total	100	201	39	70	16	426	75	501	0	22	523
7	Direct purchases abroad by residents	0	0	0	0	0	0	10	10	0	0	10
8	Output at basic prices	100	201	39	70	16	426	85	511	0	22	533

Use table at purchasers' prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES (NACE)						FINAL USES								
		Agriculture	Industry	Trade services	Private services	Other services	Total	Private consumption	Consumption of non-profit organisations	Government individual comsumption	Government collective consumption	Gross fixed capital formation	Change in inventories	Exports	Total	Total use at purchasers' prices
No		1	2	4	3	5	6	7	8	9	10	11	12	12	13	14
1	Products of agriculture	30	5	0	11	3	49	52	0	0	0	0	3	30	85	134
2	Manufactured products	5	70	2	12	5	94	74	0	2	0	40	2	45	163	257
3	Trade	1	2	5	2	1	11	2	0	0	0	0	0	0	2	13
4	Private services	10	20	11	15	0	56	32	0	3	0	4	0	10	49	105
5	Other services	0	0	0	0	0	0	2	1	5	6	0	0	0	14	14
6	Total	46	97	18	40	9	210	162	1	10	6	44	5	85	313	523
7	Direct purchases abroad by residents	0	0	0	0	0	0	10	0	0	0	0	0	0	10	10
8	Domestic purchases. by non-residents	0	0	0	0	0	0	- 20	0	0	0	0	0	20	0	0
9	Total	46	97	18	40	9	210	152	1	10	6	44	5	105	323	533
10	Compensation of employees	23	60	9	16	6	114									
11	Other taxes on production	4	9	1	2	1	17									
12	Subsidies on production	- 1	- 1	0	0	0	- 2									
13	Consumption of fixed capital	3	6	2	2	0	13									
14	Operating surplus, net	25	30	9	10	0	74									
15	Value added at basic prices	54	104	21	30	7	216									
16	Output at basic prices	100	201	39	70	16	426									

Production approach		Income approach		Expenditure approach	
Total output at basic prices	426	Compensation of employees	114	Private consumption	152
- Intermediate consumption at purchasers prices	- 210	+ Other taxes on production	17	+ Consumption of non-profit organisations	1
		- Subsidies on production	- 2	+ Govrernment individual comsumption	10
		+ Consumption of fixed capital	13	+ Government collective consumption	6
		+ Operating surplus, net	74	+ Gross fixed capital formation	44
= Gross value added at basic prices	216	= Gross value added at basic prices	216	+ Change in inventories	5
				+ Exports	105
+ Taxes less subsidies on products	22	+ Taxes less subsidies on products	22	- Imports	- 85
= Gross domestic product	238	= Gross domestic product	238	= Gross domestic product	238

Then, each local KAU is partitioned into units of homogeneous production (UHP). A homogeneous branch consists of a grouping of UHPs. For example, local KAU agriculture is divided into 3 UHPs with an output of products of agriculture (98), manufactured products (1) and private services (1).

In this example, we assume that we have production and generation of income accounts at the institutional unit level. At the level of each local KAU, we only have output and value added, and also the number of wage and salary earners. In order to compile a generation of income accounts by industry, it is thus necessary to allocate the different components of value added (compensation of employees, taxes and subsidies, etc.) in the use table (section value added) by means of some assumptions.

Our example in Table 5.5 consists of two parts:

1. The supply table shows in the rows in which industry a product is produced (output matrix). The columns of the table also show other components of the supply of products: imports, and the valuation matrices for the transformation into purchasers' prices.

2. The use table shows the uses of products. Products can be used for intermediate consumption of industries as IC by industries (intermediate use matrix) or as final uses (final use matrix).

In the supply table, output at basic prices plus imports CIF gives total supply at basic prices. If taxes less subsidies on products, trade, and transport margins are added, total supply at purchasers' prices can be calculated. Total supply at purchasers' prices of the supply table is equivalent to total uses at purchasers' prices in the use table.

For the sake of simplicity, we also assume that output by industry makes up total market output, output for own final use and other non-market output.

In the use table, government final consumption expenditure can be split into two categories:

- Government individual consumption expenditure: the individual expenditure benefits directly the individuals in the society (i.e. education, health and social work services).
- Government collective consumption expenditure: the total expenditure benefits society at large (i.e. public administration, defence, security).

The use table provides a breakdown of value added into compensation of employees, operating surplus, and other net taxes on production. This part can be supplemented with non-monetary data such as numbers of employees, labour inputs, stocks of fixed assets, and gross fixed capital formation.

In the supply and use tables, correction rows have to be introduced for direct purchases abroad by residents and purchases on domestic territory by non-residents. Final consumption expenditures by households refer to expenditures incurred by resident households. On the other hand, because detailed data on imports and exports refer to cross-borders movements, final consumption expenditures, as shown, broken down by products, is a concept of final consumption on domestic territory.

In order to obtain the correct final consumption expenditures by households, it is thus necessary to

- add direct purchases abroad by residents, both to imports (+10) in the supply table and to final consumption expenditures of households (+10) in the use table, and to
- subtract purchases on domestic territory by non-residents from the final consumption expenditures by households (-10) and the same amount to exports (+10).

We find the two identities mentioned before by row and by column. Output of agriculture (100) is equal to intermediate consumption (46) plus value added (54) and total supply of products of agriculture (134) is equal to total use of products of agriculture (134). The same holds for every industry and each product and also for the national totals for total output (426) and total supply respectively total uses (528).

Gross domestic product is equal to 238 in the example. There are three ways to calculate GDP.

- GDP = Output - Intermediate consumption + Taxes less subsidies on products
  238 = 426 - 210 + 22

- GDP = Value added at basic prices + Taxes less subsidies on products
  238 = 216 + 22

- GDP = Final uses - Imports
  238 = 323 - 85

In Table 5.4, final consumption expenditure is broken down according to the institutional sectors which actually incur expenditures for different purposes. Expenditures made by government for collective purposes such as public administration, defence, security, general health improvement, etc., benefit society as a whole, but not specific individuals. In Table 5.4, it corresponds to the amount of 6. This is referred to as the collective consumption expenditure of general government.

Besides expenditure for collective benefit, the government also incurs expenditures which benefit specific individuals, for instance health care, education, food aid, etc. These items are classified in division 14 if the Classification of Individual Consumption by Purpose (COICOP) and cross-classified with divisions in the Classification of the Functions of Governments (COFOG). This is referred to as individual consumption expenditure of general government.

The final consumption expenditures by general government on individual goods and services are also called social transfers in kind by general government in SNA 1993 and ESA 1995. Social transfers in kind provided to individuals may take two different forms:

a) *Social benefits in kind* can be subdivided into those where beneficiary households actually purchase the goods and services themselves and are reimbursed, and those where the relevant services are provided directly to the beneficiaries. In this second case, general government units or NPISHs produce or purchase, entirely or in part, goods and services which are directly provided by their producers to the beneficiaries. In Table 5.4, the corresponding figures are 2 + 3.

b) *Transfers of individual non-market goods or services* consist of goods or services provided to individual households free or at prices which are not economically significant, by non-market producers of government units or NPISHs. Accordingly, they are included in their output. In Table 5.4, the corresponding figures are 1 (coming from NPISHs) plus 5 (coming from general government).

Thus final consumption expenditure by general government and NPISHs sectors which is made for the benefit of individuals can be added to households' final consumption expenditures in order to derive households' actual final consumption. The latter concept measures the actual final consumption of households whether paid for by themselves or by other institutions.

5.4 Intermediate consumption

The quadrant of intermediate uses shows intermediate consumption at purchasers' prices, by industry in columns, and by product in rows.

Intermediate consumption includes all non-durable goods and services with an expected life of less than one year which are used up in the process of production by industries, thus excluding any goods purchased for resale without any further processing. The 'bought and not-consumed' goods are entered in changes in inventories. Goods paid for by employers for the benefit of their staff can be regarded as remuneration in kind entered in compensation of employees.

Intermediate consumption is not identical to deliveries. It is necessary to take into account changes in inventories of consumable materials. Some deliveries can be stored and consumed in the following years, and likewise, goods can be consumed which were stored during the previous years. For example, if purchases are 1000 and if changes in inventories of consumable materials are equal to +150 (assuming that the closing stock of inventories is higher than the opening stock), the intermediate consumption is 850.

Intermediate consumption at purchasers' price = Purchases + Intermediate deliveries +/- Changes in inventories of materials and supplies (according to conventions of business accounting)

This definition implies specific processing. The row 'Total' shows intermediate consumption by industry at purchasers' prices. No recording is necessary in this quadrant for trade and transport margins, taxes or subsidies on products, because of valuation at purchasers' price, which integrates these components. Purchasers' prices exclude deductible VAT, but they can include some amount of non-deductible VAT.

The format (number of industries and products) of the quadrant of intermediate uses is identical to that of the supply table (output matrix).

5.4.1 General approaches

The most commonly used approach consists of starting from the total intermediate consumption by industry, i.e. the row 'Total'. Then, there is a balancing process with the amounts which are available for intermediate use in the different product commodity flows. Finally, an equilibrium is obtained between the sum of the row 'Total' and the sum of the column 'Total'.

Nevertheless, in some countries, especially countries in which accounts rely on data sources on enterprises (institutional approach), intermediate consumption may be initially known at the level of the whole economy. Thus, the main problem consists of distributing this total intermediate consumption among industries.

Statistics on outputs and inputs for non-financial activities are collected by many countries through censuses for the benchmark years and supplemented annually by annual surveys on establishments. However, intermediate consumption in SUT (supply and use tables) is usually a broader concept than the equivalent definition in these surveys.

Another source of information is the business accounts of enterprises. However, some adjustments are necessary to pass such information from the intermediate consumption of these accounts to the intermediate consumption of national accounts.

Box 5.3: The breakdown between final expenditure and intermediate consumption

The example focuses on information and communication technologies (IT) equipment and software.

The measurement of GDP is partly determined by the breakdown of expenditure between “final expenditure” and “intermediate consumption”. The borderline between a current expense and an investment is not always clear-cut, especially in the case of information and communication technologies (IT).

As a result, the estimates of software gross fixed capital formation (GFCF) for European countries are based on firms’ accounting data. The breakdown between intermediate and final uses is therefore very different in the European countries and in the United States. This difference may be explained by differences between European and United States industrial processes. But it appears, in fact, to be a more prosaic matter of different statistical conventions.

In European countries, the starting point is the amount of the additions to fixed capital declared by firms, and then using an approach via the demand side. This makes it possible to avoid the double counting inherent in sales statistics and the fact that part of the software is already incorporated in the equipment. It also makes it possible to remain close to the recording of corporate earnings as shown in companies’ books, although, at the same time, it is affected by uncertainty over the quality of the responses from firms. In the United States, on the contrary, the national accounts statisticians have chosen a supply-side method, by classifying the total of the sales by the IT services companies falling under the “pre-packaged software” and “computer programming” as GFCF.

In the one case, therefore, priority is given to consistency with company accounts, while on the other, starting from the idea that firms do not allocate all the software to fixed capital, the inverse convention has been adopted. When is the activity of the IT department of such a firm an addition to fixed capital? When is it a current expense? It has to be admitted that the breakdown is partly conventional in nature. However, departing from the recording carried out by the firms’ accountants has the disadvantage of arriving at profit ratios in the national accounts that differ substantially from those in the private accounts. Counting all software as investment amounts to substantially increasing the current profit ratio derived from the private accounts. Moreover, recording as GFCF the total of sales could lead to double counting, notably as a result of sub-contracting. In any case, it would have been desirable to adopt the same conventions on both sides of the Atlantic.

Note that inputs as reported in business accounts are rarely detailed enough for the purpose of SUT compilation. Even when more detailed business accounts are obtained, they contain only broad categories of inputs. For example, the category of other services is reported instead of the detailed information such as computer and related services, research and development services, other business services etc. In these cases, it is necessary to make supplementary surveys to break down these aggregate items.

5.4.2 Compilation of intermediate consumption by industry

In the use table, we are looking for input structures that best describe technical relationships in production techniques. It is therefore always best to classify activities in as much detail as possible and, if aggregation is necessary, only activities with similar input structures should be aggregated. The main reason is that if an industry in a use table is an aggregate of many activities, each with a different set of inputs, then when the shares of outputs of each type of activities change, the aggregate input structure of the industry changes, even though the input structures of the component activities remain unchanged.

5.4.3 Compilation of intermediate consumption by products

Intermediate consumption of different products is in general calculated by difference, after a balance with changes in inventories at users, except when precise information on the total of intermediate consumption is available, where the following applies:

When commodity flows are compiled at a very high level of detail, intermediate consumption is often the only use or almost the only use. This is the case for some services to business which are not exported, such as security or cleaning. Note that there is a need for statistical surveys on the intermediate uses of services, including trade and transport, because they now represent about 66% of GDP in Europe.

In a second case, the total of intermediate consumption is known via information on uses by the various users. This can often be the case for energy products, research and certain business services (advertising, data processing departments, etc.). The best example can be given when a company is in a position of quasi-monopoly (like large public-sector firms) which enables it to know its customers (enterprises and households).

5.4.4 Special treatments

Diagonal

The diagonal records the intermediate consumption that an industry makes of products which correspond to its main activity. Thus, one finds here:

- Inter-establishment deliveries carried out between establishments belonging to the same enterprise. They are recorded in the total output of the enterprise as a whole.
- Intra-establishment deliveries, i.e. deliveries of goods and services produced and consumed within the same accounting period and the same establishment are not recorded as part of production of that unit, thus are not included in either intermediate consumption or output.

Inter-deliveries may not give rise to sales and so their value must be adequately estimated. Deliveries which are not sold must also be entered in the diagonal, i.e. the exchanges between two local KAU without there being invoicing.

For agriculture, the diagonal corresponds especially to the production of hay and forage, for which there is no market, and also grains and plants for sowing and planting. Market prices are applied to the known quantities.

In energy, one part of the output of certain goods - specifically designed in the NACE - is consumed within the same group of the NACE in which they are produced: hard coal consumed by coal mines in the production of coal briquettes; lignite consumed in the production of lignite briquettes, coke and coke dust, natural gas, refinery products and other petroleum products; electrical energy consumed by power stations and their auxiliary services; energy consumed for pumping.

Treatment of general contractors (sub-contracting)

The practice of sub-contracting requires particular attention. It means that a company works with the exclusive specifications ordered by another company (the buyer). The sub-contractor manufactures either spare-parts (components) or semi-finished products that will integrate directly into the buyer's final product.

In practice, it is necessary to first distinguish specialised sub-contracting. Whenever a firm, because of its own strategy, does not intend to master a specific part of the industrial process, it will then call for a specialised sub-contractor, selected upon twin criteria of know-how and technical equipment. This sub-contracting may relate to goods (e.g. raw materials or manufactured goods) or services and to an activity different from that of the company which buys it. One must regard the provided raw material as intermediate consumption.

In another situation, though used for making a product itself, a firm exceptionally delegates some particular production to a sub-contractor because it does not have the 'capacity' (sub-contracting of capacity). This occasional call for sub-contracting is quite separate from specialised sub-contracting. The diagonal includes this sub-contracting of 'capacity'.

Sometimes, in the case of construction, one carries out a consolidation of flow (for example, when the management of part of the building site is transferred). However, it is normal to value that sub-contracting, which forms the largest single purchase for this industry (see supply chapter).

Finally, it is important to distinguish in 'commodity flows' this sub-contracting from other 'internal exchanges' because of the wide variety of reasons for doing so, which are not technical.

Trade

A row is devoted to trade services (car-servicing and other repairs). Conversely, trade margins paid by the different industries on their intermediate consumption are already counted in the purchasers' price of the intermediate consumption. Let us recall that the total output of the trade industry is the sum output of the repairs carried out by trade and of the trade margins generated by trade. On the other hand, the total of trade margins by product is equal to trade margins generated by the trade industry plus trade margins coming from secondary activities of other industries.

Insurance services (non-life)

Let us recall that, even if insurance premiums usually appear as operating costs in business accounts, the insurance service is measured in a different way in national accounting, through the equation:

Insurance service = premiums earned + premium supplements – claims due.

The value of the service may be allocated to the various uses using the distribution of premiums.

Administration

A row is devoted to the non-market services (administration, defence, except health, education and research). Normally these services are consumed by every institutional unit, but according to rules which are difficult to determine since there is no actual payment. Thus, these services are by convention subject only to final consumption expenditure by general government. As a consequence, there is no intermediate consumption of these services. However, for many non-market services payments are due which do not cover all actual costs of the government service. In this case, the actual payment for a non-market service should be reported as intermediate consumption of a non-market service. The remaining rest of payment less costs is reported as final consumption expenditure of the general government.

Transport services

Transport of goods is usually treated as transport margins (see chapter 6) and thus is not shown as an intermediate consumption item. Nevertheless, some records are made with respect to transport services on intermediate consumption rows in some few cases. It is common in the trade industry to organise for oneself the transportation of the goods you resell, without invoicing separately for this purpose: this corresponds to an intermediate consumption of transport services by trade industry. Also, uses of infrastructure or storage (airports, parking, etc.) services, which are included as transport activities in international classification, are intermediate consumption of carriers.

However, it is important to keep in mind that transport margins cover only the share of total transport services that is not already shown separately as intermediate consumption of transport services in the accounts of the units that sell or buy the transported goods.

5.5 Final consumption expenditure

In ESA 1995, two concepts of final consumption are used: final consumption expenditure and actual final consumption. Final consumption expenditure is a concept that refers to a sector's expenditure of consumption goods and services. In contrast, actual final consumption refers to the acquisition of consumption goods and services. The difference between these concepts lies in the treatment of certain goods and services financed by the government or non-profit institutions serving households (NPISH) but supplied to households as social transfer in kind.

Table 5.6: Articulation between final consumption expenditure and actual final consumption

	Expenditure of sector			Total aquisition
	Government	Non-profit institutions serving households (NPISH)	Households	
Individual consumption	X (= social transfers in kind)	X (= social transfers in kind)	X	Households' actual indivdual final consumption
Collective consumption	X	0	0	Government's actual collective final consumption
Total	Government's final consumption expenditure	NPISHs final consumption expenditure	Households' final consumption expenditure	Actual final consumption = Total final consumption expenditure

Actual final consumption of households is not shown explicitly in the final uses section, but it can easily be derived by adding the following three columns in Table 5.6.

a) Final consumption expenditure of households (including household expenditures in goods and services provided by general government);

b) Final consumption expenditure of NPISHs (always considered as individual);

c) Final consumption expenditure of government which are individual.

Final consumption expenditure of government and NPISHs includes not only their non-market output (valued by costs), but also direct purchases of goods and services by them, which are not part of their intermediate consumption because they are distributed to the population without any transformation. They are goods and services which are produced by market producers, and directly delivered to households, but which are financed by government or NPISHs.

Table 5.7: Example for articulation between final consumption expenditure and actual final consumption

		Government collective consumption	Actual household consumption			
			Consumption of non-profit institutions	Government's individual comsumption	Private consumption	Total
No		1	2	3	4	5 = 2+3+4
1	Products of agriculture	0	0	0	52	52
2	Manufactured products	0	0	2	74	76
3	Trade	0	0	0	2	2
4	Business services	0	0	3	32	35
5	Other services activities	6	1	5	2	14
6	Total	6	1	10	162	179

Table 5.7 shows the articulation of the two concepts according to our fictitious example from Table 5.5. Final consumption of market products consists of health market products (dentists, doctors, medication, etc.) which are reimbursed by the social welfare.

5.5.1 Households final consumption expenditure

Household final consumption expenditure primarily covers expenditures incurred by households to acquire consumption goods and services. It excludes expenditure devoted by households to the acquisition of dwellings, which constitute an investment in fixed assets, and those devoted to the acquisition of valuables.

Household final consumption expenditure can be subdivided into three large components:

- purchases of goods and services;
- goods and services produced as outputs of unincorporated enterprises owned by households that are retained for consumption by the members of the households (own-consumption of goods and services);
- remuneration in kind

Purchases of goods and services

Market goods and services constitute the main block. However, payments made by households at the time of consumption of some non-market services are also included here. They cover:

Purchases of new goods

They do not include the purchases of dwellings and other residences, classified in gross fixed capital formation, but they include purchases of durable goods, like motor vehicles, including those acquired through leasing contracts (see above).

Treatment of acquisition of second hand goods

At the time of the sale of a second-hand good between (resident) households, total household consumption expenditure only includes the trade margins which may be incurred for this purpose. When a household purchases a vehicle which was previously owned by a producer, a non-financial corporation for instance, as a fixed asset, it is the full value of the acquisition which is entered in consumption expenditure of the households. The same applies when the purchase relates to an imported second-hand good.

When a household sells a good which, because of this transaction, shifts from the category of consumption good to another kind of use, it is negative household final consumption expenditure. This may occur, parallel to the above, when a household sells a good to a producer for the latter's fixed capital formation, or to a non-resident. This is also the case when a household sells a vehicle to a car-breakers yard for disposal. It is also the case when, at the time the sale takes place, a consumption item becomes a valuable.

Purchases of market services

Examples may be given: repair of cars, hotel expenses, taxi payments, rents, practitioners (in a social insurance context, only for the part of the expenditure which remains payable by households), cinemas, television fees, hairdressing, etc.

The same distinction applies to durable goods acquired by households for consumption purposes (see above for more explanation) as for investment goods between operating and financial leasing. Operating leasing occurs, for instance, for car renting. When a car is acquired through financial leasing, its full value should be recorded as consumption expenditure: payments made as rents in the leasing contract should be broken down between repayments of a loan and interest. The operation gives rise to the consumption of a financial service, which is not valued as long as FISIM is not allocated among uses.

The same remarks made above for non-life insurance services hold for household consumption. However, both life and non-life insurance are concerned here. The value of the service is not measured by premiums, but according to a specific calculation: premiums + premium supplements – claims due, for non-life insurance; premiums + premium supplements – actuarial reserves for life insurance.

Payments on non-market services

At the time some non-market services are supplied to households, it happens they make partial payments which do not cover the major part of the cost of services thus provided: museum entrance duties, scholarship fees. Household final consumption expenditure includes only these partial payments (see ESA 1995 paragraph 3.45 and 3.76 i).

Shares between manufactured goods and services

The treatment of products which include both a good and a service is a significant issue because of its relation with the development of a harmonised price index, which depends on the weightings of products. This is illustrated by the changing of car tyres carried out in a specialised enterprise. In countries where business sources (retail trade) are dominant, it is possible to make the separation between the consumption of the good and the consumption of the service, and consequently to record their values in the respective products. It is well known, however, that this sharing may be imprecise. In countries where household surveys prevail, on the contrary, the whole expenditure will be recorded as a consumption of repair services.

Own-consumption of goods and services

It is the counterpart of the output of households which is intended for their own final consumption.

In theory, all goods may be subject to own-consumption. In accordance with ESA 1995, it only has to be recorded in countries where subsistence farming is significant in comparison with the total supply of the concerned goods. The agricultural products concerned include potatoes, fruit, honey, meat, poultry, milk, butter, wine, brandy, champagne, etc.

Own consumption of services relates to the two cases of services of dwellings occupied by their owners and domestic and personal services produced by employing paid domestic staff (services resulting from unpaid services provided within households are not retained). Examples are: services of maternal assistants, domestic servants, gardeners.

Income earned-in-kind

This consists of goods and services which are provided free, or at a price lower than their usual purchasers' price, by employers to their employees. It can relate to goods and services produced by the employer's enterprise, as well as purchased by it. These goods and services are always regarded as resulting from a market output. Examples are: free gas or coal supplied to staff, meals provided to the staff of a restaurant, quotas of free telephone calls for the staff of telephone enterprises, etc.

The remuneration in kind provided to soldiers (clothing, food, transport) as well as payments of employers to enterprises' committees are also taken into account. In general, if the good or the service is provided free, the value which is entered as remuneration in kind corresponds to the purchasers' price if the product is bought by the employer, at the basic price if it is produced by the employer. If the good or the service is provided at a reduced price, only the part financed by the employer forms part of the remuneration in kind. In this case, however, the entirety of the value of the good or consumed service enters the final consumption expenditure of the households.

5.5.2 Actual final consumption and final consumption expenditure

Household actual final consumption is obtained in adding to household final consumption expenditure social transfers in kind by general government and NPISHs. Likewise, actual final consumption of general government is obtained in subtracting from final consumption of general government the social transfers in kind it provides. Actual final consumption of general government is restricted to collective final consumption expenditure. Actual final consumption of NPISHs is zero, all their final consumption expenditures being individual by convention, and transferred to households as transfers in kind.

Individual final consumption expenditure of general government relates to goods and services known as individual: they are goods and services of which it is possible to observe the acquisition by a particular household or a restricted group of households, for the supply of which the household(s) in question gave its agreement, and the consumption of which by a household or a restricted group people prohibits its consumption by others. Examples of individual expenditure are: expenditure on education, health, culture.

Collective consumption expenditure of general government relates to services known as collective: they are services which are provided at the same time to all the members or to significant parts of the community, the use of which is normally passive or does not require the explicit agreement of the beneficiaries, and the consumption of which by an individual does not reduce the amount which remains available for the other members of the community. Examples of collective expenditure are: expenditure related to defence, justice, general administration.

Social transfers in kind consist in individual goods and services provided as transfers in kind to households by government units (including social security funds) and NPISHs, whether purchased on the market or produced as non-market output by government units or NPISHs. A distinction is made between:

- Social benefits in kind, which consist in transfers in kind with a social purpose.
- Transfers of individual non-market goods and services, which mainly involve expenditures by government (and NPISHs) in education and culture.

5.5.3 The final consumption by purpose

In the breakdown of final consumption by purpose or by function consumption items are shown according to a classification which corresponds to the needs that consumption satisfies. Transition tables between the respective classifications of products and purposes are used.

The following items constitute the ten main purposes:

1. Food, beverages, and tobacco
2. Clothing and footwear
3. Housing, water, electricity, gas, and other fuels
4. Furnishings, households equipment, and routine maintenance of the house
5. Health
6. Transport
7. Leisure, entertainment, and culture
8. Education
9. Hotels, cafes, pubs, and restaurants
10. Miscellaneous goods and services

In a classification by purpose, products are grouped in a rather conventional way, being either complementary – i.e. simultaneously necessary to the satisfaction of a same need – or substitutable and an alternative for the satisfaction of the same need. The goods and services which are intended to satisfy a same need are thus grouped in this classification. For example, the function “transport” groups purchases of vehicles, their repair and maintenance costs, fuel consumption, expenditure on rail-transports, lorry transports and air transports.

Moreover, the classification of functions has the advantage of being the international standard. It is used in the publications of the Office of the United Nations and the OECD. This is why it is entirely appropriate for comparisons between countries.

5.5.4 Estimation methods used in practice from statistical sources

Final consumption expenditure should be estimated by the commodity flow approach, using various sources. The most common sources are: information obtained in the preparation of industry outputs, annual surveys, annual reports of industrial associations or societies, reports of public utility undertakings, reports from the tourist industry, household expenditure surveys, and censuses on retail sales and on services.

Data on household expenditures collected in household surveys are useful for making benchmark and annual estimates of distribution of household expenditures by broad categories (i.e. objects of expenditure).

To break down these broad expenditures into a more detailed product classification, and to supplement the gaps in the household expenditure surveys, which are generally based on small samples, it is necessary to resort to a census of retail sales or annual retail sales statistics. In an annual enterprises survey, it is possible to distinguish the sales by trade industries according to the different kinds of products. For example, it is possible to know sales of fuel by supermarkets, and so on. It is then possible to compile a table called ‘products-industries matrix’. However, household surveys would not give any estimate on imputed gross rents, or direct information on imputed service charge of banks, non-life and life insurance, though interest and premium payments may be given, and these ESA-defined expenditures must be independently estimated.

In practice, one team can establish an estimate of the household final consumption expenditure at a very detailed level, from a ‘use’ point of view, whilst having in mind the preoccupation of total consistency and the synthesis of the whole consumption. For one base year, this team directly and indirectly compares, by level, the results of the surveys on consumption expenditure with the results of the majority of the other sources: output, foreign trade, administrative forms, private panels of households or trades, and so on. The entire results of this first stage are subjected to two later tests: that of ‘commodity flows’ and that of the retail trade sales.

In a second step, the proposals made by consumption statisticians are introduced, at a detailed level of classification, in commodities flows. If such proposals are considered inconsistent with the supplies and uses, a check is carried out on both sides, until an agreement is reached.

Proposals made by consumption statisticians are, in addition, subject to a check with the retail trade sales. This check is partial, in the sense that it relates only to the part of consumption which is likely to be sold through trade. All the services are thus excluded, as well as products such as gas and electricity. In addition, it can only be made by groups of products (about 30) because of the difficulty in carrying out a fine analysis of the turnover of non-specialised trade.

5.6 Gross capital formation

There are three categories of capital formation in ESA 1995:

- Gross fixed capital formation,
- Changes in inventories,
- Acquisitions less disposals of valuables.

In an input-output table, they constitute distinct uses which are shown in different columns, and which are classified by products. The column for gross fixed capital formation includes acquisitions minus disposals of fixed assets, tangible assets (buildings, machinery, transport equipment, etc.) and intangible assets (subsoil assets, software assets, entertainment, literary and artistic originals), as well as improvements to non-produced assets (land).

The column for changes in inventories concerns inventories of materials and supplies, finished goods, goods for resale, and work-in-progress.

The category of valuables includes precious metals and stones (gold, diamonds etc.), jewels made from them, as well as paintings and sculptures recognised as works of art, which are acquired as stores of value and not to be used for production or consumption purposes.

The three categories of gross capital formation all are measured by acquisitions less disposals.

5.6.1 Gross fixed capital formation

Gross fixed capital formation – which constitutes the most important of the three categories – is recorded at the time the ownership of the fixed assets is transferred to the units which intend to use them to produce. This general rule needs more precision in the case of financial leasing or own-account capital formation.

Assets acquired under a financial leasing are recorded when the user of the fixed assets takes possession of them: preference is given in this respect to economic ownership, i.e. by the user, rather than to purely legal ownership. Own-account capital formation is recorded as long as the relevant assets are produced.

When fixed assets are acquired through a loan or a financial leasing, the transfer of their (economic) ownership may take place some time only after that the assets are actually used in the output. However ESA 1995 considers that the user takes ownership on them at the time physical possession of them is taken.

Gross fixed capital formation is thus recorded at this time. This treatment leads to a more homogeneous recording of the use of the fixed assets and of the localisation of value added within the framework of the input-output table.

An existing fixed asset can be sold or otherwise disposed of, and its ownership is transferred from its initial owner to the new one. When the ownership of an existing fixed asset is transferred, a positive acquisition is recorded for the new owner and a negative one for the previous owner.

Categories of investment

GFCF is measured by the total value of a producer's acquisitions, less disposals, of fixed assets during the accounting period, plus additions to the value of non-produced assets realised by productive activities of resident producers. Thus, they consist of: acquisitions less disposals of tangible produced (fixed) assets land) – including those acquired through financial leasing, costs of ownership transfer and expenditures of intangible assets (mineral exploration, software, entertainment, literary and artistic originals).

Valuation of GFCF from statistical sources

In practice, it is important that data on GFCF be classified by type (i.e. by product) and by industry. One reasonable approach to estimate GFCF by product is first to set up a matrix of GFCF by industries cross-classified by institutional sectors and by general types of goods (dwellings, other buildings and structures, transport equipment, other machinery and equipment). The next step is to expand the general types of goods into more detailed products using the commodity flow method. The commodity flow approach is very useful in some cases, for example PRODCOM from the 5-digit SIC (92), to estimate the share between intermediate consumption and GFCF. It can also help to identify capital goods from domestic production, imports and exports by the nature of goods. However, GFCF data by industry and by product collected via business surveys is the best approach. The commodity flow method is an alternative and of lower quality.

Valuation of acquisitions

The measurement of acquisitions of tangible assets does not raise too many problems in general, since annual enterprises surveys or fiscal accounts provide information about this type of data.

Valuation of disposals

Measurement of disposals may be more difficult. They have to be valued at market prices. However disposals as they are derived from business accounting are measured at their written off accounting value, taking into account depreciation (written off value of assets is equal to their historic value of acquisition minus depreciation).

Depreciation can be calculated in business accounts using a linear or decreasing pattern, according to accounting practices. This measure of depreciation does not usually lead to actual market values for assets to which it is applied. Starting with this estimate, and using for instance fiscal sources, it is possible to get values close to market ones in estimating holding gains and losses on disposals, by reference to exceptional gains/losses from the profits and losses accounts of business.

It should be noted that for second-hand capital goods which already exist in the economy, a purchase by one institutional sector – say, unincorporated enterprises of the household sector – must be netted out by a sale of the same value by another institutional sector – say, the non-financial corporations sector. The increase in gross capital formation is measured by the transfer cost only.

Valuation of intangible assets

The capital formation of intangible assets such as software, including data-processing programs on own-account, must be valued from surveys. Literary and artistic capitalised output could be valued from enterprises accounts. In practice, capitalised output represents the value of intangible assets created by film or program producers. When exploited, these assets will subsequently generate revenues in the form of rights or share of box-office receipts.

5.6.2 Changes in inventories

Changes in inventories held by producers, general government and non-profit institutions serving households are the second main component of gross capital formation. They cover the following:

a) Inventories (or stocks) of raw materials and stocks of semi-processed or finished products purchased by producers for use as input into their production process;

b) Work-in-progress refers to goods produced during the accounting period but in need of further processing to be sellable on the market;

c) Livestock raised for slaughter (but breeding stock, draught animals, dairy cattle and animals raised for wool and fur clips should be treated as fixed assets);

d) Inventories of finished products produced as output but unsold.

In the commodity flows, three categories of changes in inventories are distinguished:

- Changes in inventories at the producers, which are shown both as resources and as uses;
- Changes in inventories stored by users and the trade.

Statistical sources

Basic sources are **surveys carried out at enterprises**. They are of an accounting nature, providing information on respective levels of opening stocks of inventories and closing stock of inventories. They give data by industry.

From a very simplified example, it is possible to show how, in a commodity flow context, intermediate use of a product and changes in inventories at purchasers of the same product are consistent. Let us assume a company which buys a product (x) for an amount of 1000 during one year and whose stocks of inventories in this product are 200 at the beginning of year and of 300 at the end of the year. In the absence of price movements during the year, changes in inventories amount to: 100 = 300 - 200. Intermediate consumption is equal to Purchases minus Changes in inventories. It thus equals 900.

On the other hand, quantity data on inventories may be available for some specific products. This is especially the case for agricultural goods and energy goods. The advantage is that information is directly available by product.

Valuation issues

The main problem with data from enterprises is that, from the data on respective opening and closing stocks of inventories, it is not straightforward to directly derive changes in inventories, since stocks also include holding gains, especially when prices grow rapidly. Holding gains (eventually losses) accrue from the simple case of goods being held in stocks, regardless of whether they were present or not in stocks at the beginning of the period. In very simple cases, it may be sufficient, in order to eliminate holding gains, to apply a price index to the opening stocks which is representative of the kind of products held in stocks. However, in many cases it will be necessary to use methods which take account of the accounting conventions which are retained by enterprises in their own bookkeeping (first in-first out, last in-first out, etc.).

The second issue deals with the allocation of changes in inventories by products, since basic information is by industry.

- As far as **inventories of producers** are concerned, some simple assumptions allow rather good allocation by products.
- **For trade inventories**, a similar method may be applied. It assumes, however, that the classification of trade industries is sufficiently detailed. If this is not the case, it is possible to use empirical information on trade net-works.

  Consider the estimation of the inventory changes for a trader of the product “leathers and skins”. The company data of the sector “wholesale of leathers and skins”, which belong to trade in the classifications, gives stock beginning minus final stock including appreciation -11 which one converts into +11 to have final stock minus stock beginning (see before). Final stock is, in addition, 354 in the commercial sector, i.e. a stock beginning of

343 = (354 - 11). By applying a price index of 102% to this final stock (of output of leathers and skins), one obtains a stock beginning except appreciation of 350, i.e. an inventory change in the tradesmen of 4 = (354 - 350).

- For **users' inventories**, the issue is far more complex since it necessitates making assumptions on the product composition of inventories, relying on the structure of purchases.

  From business accounting, one has inventories resulting from purchases. One can then evaluate stocks of users by industry. In the same way, starting from the levels of each quarter resulting from business surveys of stocks, one estimates changes in inventories.

  To get to the changes in users' inventories by product, one reverses the input-output table by distributing stocks of users by industry in proportion to the intermediate consumption by industry. One thus obtains a decomposition of the changes in users' inventories by column. Then, by making totals by row, one estimates a total of changes in users' inventories by product.

  For example, if the inventory changes of the industry "leathers and skins" are 100 according to this source and the input-output table shows that this industry consumes only two products, agriculture for 60% and textile and clothing industry for 40%, the inventory changes of the product "agriculture" are estimated to be 60, and those of the product "textile and clothing industry" 40, and so on for all the columns.

5.7 Exports

With regard to exports (and imports), flexibility is given to countries to introduce sub-classifications (in columns) up to a reasonable level of detail. The EUROSTAT data submission program also requests the separation of intra-EU exports and extra-EU exports (this applies also for imports).

As in the supply table, some adjustment rows relating to direct purchases abroad are added in the quadrant of final use (a breakdown by products could be provided if data are available):

a) direct purchases carried out abroad by residents, which are added to the total of the column relating to households' final consumption expenditures;

b) direct purchases carried out on the domestic market by non-residents, which are added to exports of goods and exports of services, and are subtracted from households' final consumption expenditures.

Exports (as imports) of goods must be valued 'free on board' (FOB) at the border of the exporting country. FOB price includes:

- the value of goods at basic prices;
- trade and transport services to the border;
- taxes minus subsidies on products; there is no VAT on exports, including on intra-EU deliveries (at least for the time being).

Exports of services thus include the value of the transport made by a resident carrier on exported goods beyond the border of the exporting country, and of the transport made by a resident carrier on imported goods to the border of the exporting country when the imports are valued FOB and to the border of the importing country when the imports are valued CIF (cost, insurance, freight).

CIF valuation is often the case for detailed imports, i.e. in commodity flows. An adjustment has to be made in order to get a FOB valuation of total imports, which leads to subtraction of the value of transportation between the exporting country and the importing country.

A row and a CIF/FOB adjustment column in the supply table make it possible to obtain a FOB valuation for the total of imported goods. This row is, in general, shown below the territorial adjustment row. It is empty within the 'uses' section of the input-output table.

5.8 Value added

In addition, the use table includes a section containing the breakdown by industry of the balancing item of the production account (gross value added and GDP), and the breakdown by industry of the generation of income account items (categories of gross value added). Thus, this section shows the cost of each industry in terms of factor costs, for example wages and salaries paid to employees, gross (or net) operating surplus and other taxes (minus other subsidies) on production. These amounts of taxes and subsidies include production taxes paid by industry or subsidies received by industry excluding 'product specific' taxes used to derive the total supply of products in the supply matrix.

This part is crucial because it can be used to obtain one of the most important balancing items in the system: value added (or the gross value added generated by any unit engaged in a production activity) and the crucial aggregate gross domestic product (GDP). Value added in the use table reflects the interdependency of value added chains in production.

Value added may be calculated before or after consumption of fixed capital, i.e. gross or net. Given that output is valued at basic prices and intermediate consumption at purchasers' prices, value added does not include taxes less subsidies on products.

Box 5.3: Treatment of (non-deductible) VAT

The calculation of non-deductible VAT is important because output of companies is often valued without VAT from enterprise surveys. To obtain uses at purchasers' price, it is necessary to estimate non-deductible VAT. Non-deductible VAT can only be compiled from the use side of the supply and use system.

VAT applies in principle to all sales made by producers who are subjected to it, except for those intended for export. It is also included in the value of all imported products. Producers are obliged to pay only the difference between the VAT on their sales and the VAT on their purchases for their own intermediate consumption or gross fixed capital formation. In principle VAT is a tax on private consumption.

VAT is recorded net in the sense that:

a) Output of goods and services and imports are valued excluding invoiced VAT;

b) Purchases of goods and services are recorded including non-deductible VAT. VAT is recorded as being borne by purchasers, not sellers, and then only by those purchasers who are not able to deduct it (mainly household consumption).

In practice, one determines the theoretical rate for each product of the classification. Of course there may be changes in VAT rates during the year which would have to be taken into account.

Agriculture has its own particular situation. VAT appears only when the product channels through a trader who is subjected to VAT. On the other hand, in the case of direct purchases, the non-deductible VAT is not included.

The difference between this calculated theoretical VAT and the amount actually payable to tax authorities has to be eliminated. It is possible to distribute it according to the proportion of the output.

GDP is calculated at market prices. This aggregate can be derived from the supply and use table in three ways (see numerical example):

a) Production approach
The aggregate of output at basic prices by industry minus the aggregate of intermediate consumption at purchasers' prices by industry plus net taxes on products; the intermediate consumption by industry includes the use of financial intermediation services indirectly measured.

b) Income approach
The aggregates of the various components of valued added at basic prices by industry minus the use of financial intermediation services indirectly measured plus net taxes on products;

c) Expenditure approach
The sum of final uses categories minus imports: final consumption expenditure at purchasers' prices + gross capital formation at purchasers' prices + exports (FOB) - imports (FOB).

The generation of the income account is thus presented by industry, in the column of the use table. It presents the industries which are the source, rather than the destination, of primary income. It analyses the extent to which value added can cover compensation of employees and other taxes less subsidies on production. It measures net operating surplus by subtracting consumption of fixed capital from gross operating surplus.

5.8.1 Compensation of employees

Compensation of employees is defined as the total remuneration, in cash or in kind, payable by an employer to an employee in return for work done by the latter during the accounting period. Compensation of employees is broken down into:

a) Wages and salaries (in cash and in kind);

b) Employers' social contributions (actual and imputed).

5.8.2 Consumption of fixed capital

Consumption of fixed capital represents the amount of fixed assets used up during the period under consideration, as a result of normal wear and tear and foreseeable obsolescence, including a provision for losses of fixed assets as a result of accidental damage which could be insured against.

Consumption of fixed capital must be calculated for all fixed assets (except animals), including both tangible fixed assets and intangible fixed assets such as mineral exploration costs and software, major improvements to non-produced assets and costs of ownership transfers associated with non-produced assets.

Consumption of fixed capital (which should be distinguished from the depreciation shown in business accounts) should be estimated on the basis of the stock of fixed assets, and the probable average economic life of the different categories of those goods. For the calculation of the stock of fixed assets, the perpetual inventory method (PIM) is recommended whenever direct information on the stock of fixed assets is missing. The stock of fixed assets should be valued at the purchasers' prices of the current period.

5.8.3 Breakdown of some aggregates

For value added, an additional disaggregation of transaction categories could be useful. For instance, compensation of employees could be subdivided into wages and salaries and employers' social contributions, with a further breakdown of the latter into actual social contributions and imputed social contributions.

The category "Taxes minus subsidies" could be the subject of additional distinctions into taxes of VAT type, taxes on imports or import duties, or other taxes on products (other than VAT) and subsidies on imports, taxes on exports and subsidies on exports, taxes on products other than VAT, or taxes on imports and exports, and other subsidies on products.

As taxes and subsidies on products are not assigned to industries, when output is valued at basic prices, a distribution by industry is necessary only for other taxes minus other subsidies on production. This category could also be separated into a component for taxes and another for subsidies.

It is also possible to distinguish, for example, payroll taxes from other taxes on production. Mixed income and operating surplus are, on the other hand, balancing items which do not require any additional distribution. Mixed income is the term reserved for the balancing item of the generation of income account when it refers to the output of the households sector, except for owner-occupiers in their capacity as producers of services of housing.

5.8.4 Compiling the generation of income accounts in practice

The biggest problem lies with the compilation of the complete generation of income account by industry instead of institutional sectors, as a first step, because of the lack of information about some aggregates.

The first problem when using both sources of information is that the surveyed unit is different in each: 'enterprise' and 'kind-of-activity unit', though it is recommended in ESA 1995 that the institutional unit's information system must be capable of indicating or calculating (for each KAU) at least the value of production, intermediate consumption, compensation of employees, operating surplus and employment and gross fixed capital formation. The information supplied by the enterprise should thus be subdivided into as many KAUs or local KAUs as activities are carried out. The units under consideration should then be assigned to the corresponding industry in the classification of activities.

However, information on KAU or local KAU is sometimes limited to output and employment, eventually to intermediate purchases. In our example, only employment and hours worked are available by local KAU so that wages must be estimated. Because, at this stage, the standards of wages per industry are unknown as long as the Generation of Income Accounts (GIA) are not compiled, we consider that the average rate of remuneration by employment equivalent time full (EQTF) of a given local KAU is close to the rate of remuneration of the enterprise to which it belongs. Taxes and subsidies are also paid by enterprises instead of its individual establishments. These taxes must be allocated by industry. In the absence of any other information, we assume they are proportional to the output of each local KAU.

Compensation of employees and its components are collected by some countries. Thereby, compensation of employees is consistent with all the other variables for the industry. For example, the UK Annual Business Survey collects aggregates and components of turnover, purchases, inventories, GFCF, taxes, subsidies, compensation of employees, imports and exports of services from the same reporting unit. This achieves a large degree of consistency and coherency the data by industry. The sector aggregates which are derived from the industry or function breakdowns, thereby are consistent.

5.8.5 Output

In the supply table and, consequently, in the use table, it is possible to distinguish the following three categories:

- Market output
  It consists of output that is disposed of on the market.
- Output for own final use
  It consists of goods and services that are retained either for final consumption by the same institutional unit or for gross fixed capital formation by the same institutional unit. Typical examples are agricultural products retained by farmers and housing services produced by the owners of owner-occupied dwellings.
- Other non-market output
  It covers output that is provided for free, or at prices that are economically insignificant, to other units.

The valuation matrices

chapter 6

6.1 Introduction

In the supply and use system, the valuation concepts constitute an important element. Therefore, the valuation matrices shall be dealt with in a separate chapter. The chapter will cover both the supply-side as well as the use-side valuation concepts and the transformation of the use flows into a valuation which is consistent with the supply-side valuation.

How can we achieve a valuation of the supply and use flows as homogeneously as possible? This chapter deals with the various kinds of valuation matrices that are necessary to bridge the different valuation concepts of the product flows. Therefore, the main content of this chapter reflects the main concepts and methodologies of compiling matrices for trade margins, transport margins and taxes less subsidies on products.

The topics of this chapter interrelate to other chapters of this manual. A very important link exists with the chapter on balancing, as trade and transport margins also have to be balanced. Furthermore, the chapters on compiling supply and use tables also relate to this one, since these chapters cover all aspects of compiling supply and use tables. Another important link exists with the chapters on supply and use tables at constant prices and with the chapter on the transformation of supply and use tables to symmetric input-output tables.

This chapter is organised in four parts: in the first part, the valuation concepts of the system are explained which require the compilation of valuation matrices for the transformation of the supply and use data from purchasers' prices to basic prices and vice versa. In the second and third part the compilation of trade and transport margin matrices is elaborated. Finally, in the last part, the compilation of matrices for taxes and products and subsidies on products is discussed.

6.2 Valuation concepts of product flows

Transactions are valued at the actual prices agreed upon by the transactors. Market prices are thus the basic reference for valuation in the supply and use system. In the absence of market transactions, valuation is made according to costs incurred (non-market services produced by government) or by reference to market prices for analogous goods and services (services of owner-occupied dwellings).

6.2.1 Valuation concepts in the ESA 1995

The ESA 1995 distinguishes two main valuation concepts of the flows of goods and services: purchasers' prices and basic prices:

> ***Purchasers' prices:*** *At the time of purchase, the purchaser's price is the price the purchaser actually pays for the products; including any taxes less subsidies on the products (but excluding deductible taxes like VAT on the products); including any transport charges paid separately by the purchaser to take delivery at the required time and place.*
>
> ***Basic prices:*** *The basic price is the price receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable on that unit as a consequence of its production or sale (i.e. taxes on products), plus any subsidy receivable on that unit as a consequence of its production or sale (i.e. subsidies on products). It excludes any transport charges invoiced separately by the producer. It includes any transport margins charged by the producer on the same invoice, even when they are included as a separate item on the invoice.*

The difference between these two basic valuation concepts relates therefore to trade and transport margins on the one hand, and to taxes less subsidies on products on the other. Producers' prices were the main valuation concept in the former system of national accounts. When we also introduce the concept of producers' prices, the difference between these two valuation concepts can be attributed to the two factors.

> ***Producers' prices:*** *The producers' price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any VAT, invoiced to the purchaser. It excludes any transport charges invoiced separately by the producer.*

Thus, the relationship between the different types of prices can be shown as follows:

Purchasers' prices (excluding any deductible VAT)
- Non-deductible VAT
- Trade and transport margins
= Producers' prices
- Taxes on products (excl. VAT)
+ Subsidies on products
= Basic prices

Trade and transport margins are the difference between purchasers' and producers' prices, and taxes less subsidies on products are the difference between producers' prices and basic prices. Even if the concept of producers' prices is not any more part of the system, the relationship still holds. Depending on the statistical sources, the valuation at producers' prices may be an intermediate level in the compilation process. Both in the supply and use tables as well as in the symmetric input-output tables the flows of goods and services should at the end be valued at basic prices.

However, the basic data which are used to compile the supply and use tables have different valuations:

- Production and output data are usually valued at basic prices or at producers' prices.
- Data on intermediate consumption and final use are usually valued at purchasers' prices.
- Imports are valued at CIF-prices.
  Price of a good delivered at the border of the importing country, or the price of a service delivered to a resident, before the payment of any import duties or other taxes on imports or trade and transport margins within the country.
- Exports are valued at FOB-prices.
  Price of a good at the border of the exporting country, or the price of a service delivered to a non-resident, including transport charges and trade margins up to the point of the border, and including any taxes less subsidies on the goods exported.

Without separating the different valuation components of the product flows, a supply and use framework cannot be balanced and made consistent. It is thus the task of the valuation matrices to bridge the differences between the valuation at purchasers' prices and the valuation at basic prices.

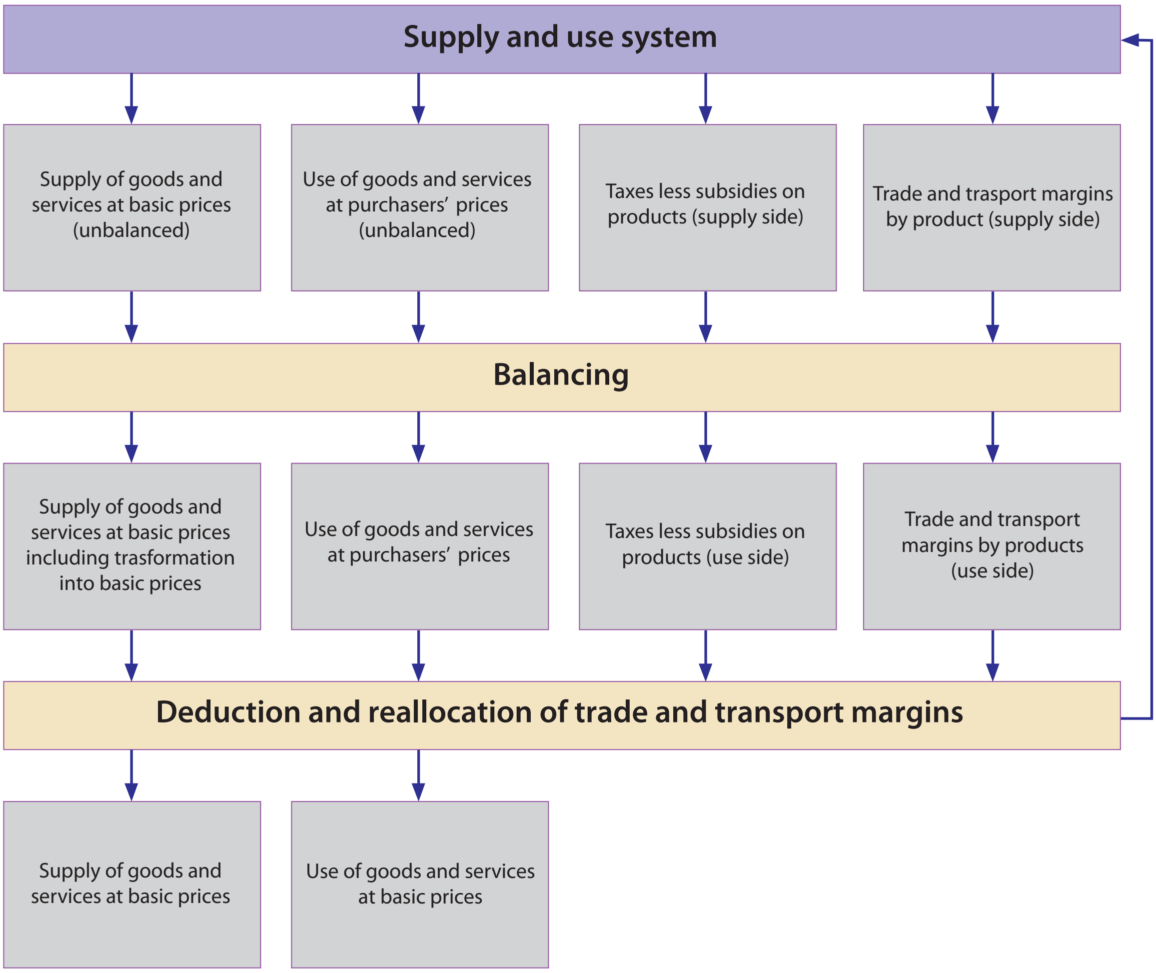
The valuation matrices comprise all flows that are related to the supply and use of trade and transport margins and the supply and use of taxes less subsidies on products. On the supply-side, valuation matrices are needed to transform supply from basic prices to supply at purchasers' prices and thus to be able to balance supply and use at purchasers' prices. On the use-side, valuation matrices are required to transform the use data from purchasers' prices into basic prices.

It may be surprising to introduce supply-side valuation matrices since valuation aspects are more likely to be seen on the use-side. However, trade and transport margins are not only items needed for the transformation of the use data into basic prices, they are also the output of activities and thus products like any other products in the system. Thus, trade and transport margins also need to be balanced and the deducted trade and transport margins from the use data must be equal to the trade and transport margins actually produced and imported on the supply side.

Concerning taxes less subsidies on products, things are of course a bit different than for trade and transport margins. Taxes less subsidies on products are not products and are therefore not produced. They are linked to the respective products, but because of the intended valuation of supply at basic prices they are separated from the output flows and import flows. Their inclusion in the supply-side is merely because of the need to add to the supply at basic prices all components to transform the supply into purchasers' prices. The estimation of trade and transport margins from the supply-side takes place before taxes less subsidies on products and non-deductible VAT. However, if trade and transport margins are estimated from the use-side the sequence should be reversed and the factors changed to reflect this sequence.

Figure 6.1 shows the valuation matrices and their role in the compilation of the supply and use framework. At the supply side, data on the trade and transport margins by products as well as data on taxes less subsidies on products classified by homogeneous products are required. These valuation matrices are then added to total supply at basic prices resulting in total supply at purchasers' prices. This approach enables the balancing of supply and use at purchasers' prices.

Figure 6.1: The role of the valuation matrices in the supply and use framework



The second kind of valuation matrices relate to the trade and transport margins and taxes less subsidies on products incorporated in the use flows at purchasers' prices. The product totals of these use-side valuation matrices should, of course, be the same as the totals on the supply side. Deducting these use-side valuation matrices from the use data at purchasers' prices results in use data at basic prices. The last step is the column-wise reallocation of the use-side trade and transport margins from the products dimension to the product margins.

It should be noted that Figure 6.1 only shows the basic structure of the compilation process relating to the valuation matrices. In practical application some of the steps could be done simultaneously and recalculations might also be required depending on the experience of the balancing procedure.

It should also be noted that a balanced supply and use framework does not necessarily end up with a valuation of both supply and use at basic prices. The use data could still be valued at purchasers' prices, with the supply data valued at basic prices. However, for analytical purposes, the use data should have the same valuation as the supply data. Also, for the transformation process of the supply and use data into symmetric input-output data, the separation of the trade and transport margins and the product taxes less subsidies included in the purchasers' prices is advisable. Moreover, for deflating gross domestic product supply and use tables at basic prices seem to be the best valuation base.

For input-output analytical purposes a valuation as homogeneous as possible is required as the input-output relations measured in monetary units are often interpreted as technical relations. A unit of a specific input product should represent the same "physical quantity" in whatever production process it is used. Thus, a valuation at purchasers' prices is a less homogeneous option as the shares of trade and transport margins differ from industry to industry and also from and between the final uses; the same is true for the shares of product taxes less subsidies. A valuation at producers' prices is obviously more homogeneous as the different shares of trade and transport margins are eliminated. In the same way, a valuation at basic prices is even more homogeneous than a valuation at producers' prices as the different shares of product taxes less subsidies are also eliminated. Thus, basic prices are the preferable valuation concept in the supply and use framework and it is also the valuation concept that in practice can be achieved.

6.2.2 The valuation matrices in the supply and use framework

Valuation matrices comprise information on trade margins, transport margins, taxes on products and subsidies on products. Valuation matrices can be established for the supply side and the use side at the same time. In a balanced supply and use system the column totals of supply-side valuation matrices and use-side valuation matrices are equal. In this subchapter a full set of valuation matrices is described in more detail.

Chapter 4 (The supply table) already explained in great detail how supply-side trade and transport margins can be compiled. At the same time it demonstrated how the vectors of the valuation matrices for trade margins, transport margins and taxes less subsidies on products were added to the supply table at basic prices to arrive at total supply at purchasers' prices by product.

Supply-side valuation matrices

The supply table in Table 6.1 can be taken as a starting point. The table shows the structure of supply at basic prices, including a transformation into purchasers' prices. The left part of this table starts with the domestic output of the various industries showing the products produced by them, valued at basic prices.

In the supply table, trade and transport margins are reported in row (4) for total supply at basic prices. To arrive at purchasers' prices for each product, trade margins and transport margins have to be reallocated from trade and transport services to the traded products. In column (12) of the supply table, a new allocation of trade and transport margins is realised with positive entries (+) in the rows of the traded and transported products and negative entries (-) in the rows of trade services and transport services. The total of column (12) of trade and transport margins is always zero.

Table 6.1: Supply table at basic prices, including a transformation into purchasers' prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)							IMPORTS				VALUATION		
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total domestic output at basic prices	Intra EU imports CIF	Extra EU imports CIF	Imports CIF	Total supply at basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Products of agriculture	6 467						6 467	1 039	874	1 912	8 380	1 903	- 262	10 021
2	Products of industry	889	111 350	626	2 749	62	248	115 925	48 544	24 269	72 812	188 737	36 181	15 988	240 906
3	Construction work	140	1 132	27 356	429	36	67	29 161	217	143	360	29 521		1 704	31 225
4	Trade, hotel, transport services	150	3 375	399	79 355	447	439	84 164	2 044	1 512	3 557	87 721	- 38 085	1 696	51 332
5	Financial, real estate, business	13	1 428	211	1 953	66 939	416	70 961	3 580	1 493	5 073	76 033		2 722	78 756
6	Other services	4	58	5	200	2	55 843	56 112	559	281	840	56 952		850	57 802
7	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790	55 983	28 571	84 554	447 344	0	22 699	470 043
8	CIF/FOB adjustments on imports								- 133	- 30	- 163	- 163			- 163
9	Direct purchases abroad by residents								4 997	3 160	8 157	8 157			8 157
10	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790	60 847	31 701	92 548	455 338	0	22 699	478 037

Austria 2000

Taxes less subsidies on products are not included in the production matrix as the output is valued at basic prices. The inclusion of the imports CIF by products results in the total supply by products at basic prices (column 11).

In column (13) the vector of taxes less subsidies of products is added to total supply at basic prices. It should be noted that taxes on products comprise value added type taxes, taxes and duties on imports and other product taxes. In consequence, subsidies on products comprise import subsidies and other subsidies on products. Column (12) and (13) refer to the supply of trade and transport margins by products and the "supply" of taxes less subsidies on products. Adding these two columns to total supply at basic prices results in total supply at purchasers' prices in column (14). The valuation vectors for trade and transport margins and taxes less subsidies on products guarantee, that finally products in column (14) are valued at purchasers' prices. Column (12) and (13) are thus the necessary bridge to compare and balance total supply with total use, both valued at purchasers' prices.

In order to compile trade and transport margins by products in column (12), the elaboration of additional submatrices is necessary which reflect supply-side trade and transport margin matrices. The structure of these matrices is shown in Table 6.2. It shows the output of trade and transport margins by products and industries. The table reports which industries have supplied trade and transport margins which are classified according to the products traded and transported. The column totals of this matrix are then entered in column (12) of the supply table (Table 6.1).

In practice, the elaboration of this supply-side trade and transport margin matrix will – depending on the data sources – be subdivided into several matrices according to the kinds of trade (wholesale, retail trade) and transport (land, water, air, etc.) margins. Thus, Table 6.2 by itself is an aggregation of analogous matrices for each of the different types of trade and transport margins covering

1. trade services of motor vehicles and motorcycles; retail sale of automotive fuel,
2. wholesale trade and commission trade services, except of motor vehicles and motorcycles,
3. retail trade services, except of motor vehicles and motorcycles,
4. land transport; transport via pipeline services,
5. water transport services,
6. air transport services, and
7. supporting and auxiliary transport services.

Both trade and transport margins can be produced by any industries, for all supply matrices. However, the bulk of the output of trade margins will be produced by the trade industries and the bulk of transport margins by the transport industries.

Table 6.2: Supply-side trade and transport margins

	INDUSTRIES (NACE) / PRODUCTS (CPA)	INDUSTRIES (NACE)						Total
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	
No		1	2	3	4	5	6	7
1	Products of agriculture	1 903						1 903
2	Products of industry	278	34 753	195	858	19	77	36 181
3	Construction work							
4	Trade, hotel, transport services	- 2 181	- 34 753	- 195	- 858	- 19	- 77	- 38 085
5	Financial, real estate, business							
6	Other services							
7	Total	0	0	0	0	0	0	0

Austria 2000

As with the supply-side trade and transport margin matrices, the column (13) of table 6.1 is the result of separate calculations on the amount and structure of product taxes less subsidies by products. Column (6) of table 6.1 is an aggregation of the different product taxes and product subsidies.

Use-side valuation matrices

Table 6.3 shows the structure of the use table at purchasers' prices. This table comprises three submatrices: the intermediate consumption matrix showing intermediate consumption by industries and products, the final uses matrix showing final uses by types and products, and the value added matrix showing the components of value added by industries.

Both the intermediate consumption and the final uses matrix are valued at purchasers' prices, thus including trade and transport margins and including product taxes less subsidies. Here it should also be noted that purchasers' prices do not include deductible VAT. Adding the column total of the intermediate consumption (column 7) with the column total of the final uses matrix (column 16) results in the total uses by products at purchasers' prices which should equal the total supply at purchasers' prices. The value added matrix is of no interest in this chapter and is treated in chapter 4 of this handbook. However, the value added matrix is needed to show the balance between the output at basic prices by industries of the supply table and the sum of intermediate consumption and value added of the use table.

The transition of the use table from purchasers' prices into basic prices involves the elaboration of use-side trade and transport margin matrices and of use-side matrices of product taxes less subsidies. Table 6.4 shows such a use-side trade and transport margin matrix. This matrix has the same dimensions as the intermediate consumption and final uses matrix at purchasers' prices. It shows the allocation of the trade and transport margins for each product to each element of the use table at purchasers' prices. Hence, it tells how much trade and transport margins are included in the purchasers' price or, in other words, which amounts need to be deducted from the purchasers' price in order to achieve the valuation of basic prices, if similarly, product taxes less subsidies are also deducted.

Table 6.3: Use table at purchasers' prices

No	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES (NACE)							FINAL USES									Total use at purchasers' prices
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exportsextra EU FOB	Total	
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	1 705	4 104	30	482	11	95	6 426	2 561		176	108		242	397	112	3 595	10 021
2	Products of industry	1 678	55 020	9 212	14 043	3 701	7 730	1 384	55 434		2 111	22 231	163	792	42 232	26 561	149 522	240 906
3	Construction work	99	542	1 993	950	3 695	1 445	8 724	1 032			20 761			429	280	22 501	31 225
4	Trade, hotel, transport services	83	4 420	401	11 129	1 321	1 493	18 847	26 586		328	67			3 285	2 223	32 488	51 334
5	Financial, real estate, business services	171	7 400	1 732	10 490	21 810	4 618	46 221	22 156		195	4 254		- 24	3 606	2 345	32 533	78 754
6	Other services	102	1 323	77	813	1 682	3 052	7 049	9 507	3 670	36 988	251	61		187	90	50 753	57 802
7	Total at purchasers' prices	3 837	72 808	13 445	37 907	32 221	18 433	178 652	117 274	3 670	39 797	47 672	224	1 009	50 135	31 611	291 392	470 043
8	CIF/FOB adjustments on exports														- 133	- 30	- 163	- 163
9	Direct purchases abroad by residents								8 157								8 157	8 157
10	Domestic purchases. by non-residents								- 12 360						9 528	2 832		
11	Total	3 837	72 808	13 445	37 907	32 221	18 433	178 652	113 071	3 670	39 797	47 672	224	1 009	59 530	34 413	299 386	478 037
12	Compensation of employees	504	25 517	8 298	26 129	14 458	32 269	107 174										
13	Other net taxes on production	- 906	908	345	981	883	810	3 021										
14	Consumption of fixed capital	1 520	6 407	1 007	6 634	9 363	4 642	29 574										
15	Operating surplus, net	2 709	11 705	5 501	13 036	10 561	859	4 370										
16	Value added at basic prices	3 826	44 536	15 152	46 779	35 265	38 580	184 138										
17	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790										

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In practice, Table 6.4 will be the result of analogous matrices for each kind of trade and transport margins distinguished. A differing valuation between supply and use with respect to trade and transport margins is only possible in the case of (tangible) goods, but not services. Therefore, the use-side trade and transport margin matrix will only have entries in the goods part of the product classification applied. This would also include non-customised software products that are classified in the service part of the European product classification.

Column (17) at the bottom of Table 6.4 must be equal to the total supply of trade and transport margins as shown in columns (12) and (13) of the supply Table 6.1. As the information basis to construct Table 6.4 is usually very poor, some balancing between the supply and use of trade and transport margins might be necessary. Furthermore, according to the database available, it may be necessary to start with Table 6.4 to arrive at an estimate of total trade and transport margins by products. In this case the use-side estimates will have to be checked by supply-side data or by plausibility at least. In the case of having estimated supply-side data first, these data will serve as a basis for allocating the supply of trade and transport margins to the various use categories. However, it should already be noted here that some balancing might be anyway necessary to achieve plausible relations for the necessary link between the supply valuation and the use valuation.

Table 6.4: Use-side valuation matrices

No	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES (NACE): Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total	FINAL USES: Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exportsextra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Wholesale trade margins																	
1	Products of agricult.	125	406	3	62	1	11	608	222			2		1	46	13	285	893
2	Products of industry	160	3 608	1 107	1 218	265	664	7 023	5 269		305	3 386		67	1 779	1 199	12 005	19 028
3	Construction work																	
4	Trade, hotel, transp.	- 285	- 4 014	- 1 110	- 1 281	- 267	- 675	- 7 631	- 5 491		- 305	- 3 388		- 69	- 1 826	- 1 212	- 12 290	- 19 921
5	Finance, real, busin.																	
6	Other services																	
7	Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Retail trade margins																	
1	Products of agricult.		33		62		2	97	634								635	731
2	Products of industry	135	348	113	706	167	236	1 705	11 639		598	1 173		33	44	21	13 508	15 213
3	Construction work																	
4	Trade, hotel, transp.	- 135	- 381	- 113	- 768	- 167	- 237	- 1 802	- 12 274		- 598	- 1 173		- 33	- 44	- 21	- 14 143	- 15 944
5	Finance, real, busin.																	
6	Other services																	
7	Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Transport margins																	
1	Products of agricult.	40	149	1	9		1	200	71			2		1	4	1	80	279
2	Products of industry	19	825	201	114	17	56	1 233	342		14	134	1	5	131	80	707	1 940
3	Construction work																	
4	Trade, hotel, transp.	- 59	- 974	- 202	- 123	- 17	- 57	- 1 433	- 413		- 14	- 136	- 1	- 7	- 135	- 81	- 786	- 2 219
5	Finance, real, busin.																	
6	Other services																	
7	Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Other taxes on products																	
1	Products of agricult.	1	22		1			25	11								11	36
2	Products of industry	108	654	189	807	159	324	2 241	3 573		4	292		3	20	25	3 917	6 159
3	Construction work			1		1		3				7					7	10
4	Trade, hotel, transp.		5	1	19	2	2	28	162								163	191
5	Finance, real, busin.	6	77	12	118	69	32	315	643			454					1 098	1 412
6	Other services		12	2	13	40	8	75	514		1						515	590
7	Total	115	771	204	959	271	367	2 686	4 904		5	753		3	20	25	5 711	8 397

	Subsidies on products																	
1	Products of agricult.	- 5	- 268		- 43		- 8	- 325	- 149					- 2	- 35	- 11	- 196	- 522
2	Products of industry	- 4	- 105	- 24	- 26	- 4	- 13	- 177	- 94		- 3	- 17		- 1	- 73	- 40	- 228	- 405
3	Construction work			- 1	- 1	- 3	- 1	- 6	- 1			- 14					- 16	- 22
4	Trade, hotel, transp.	- 2	- 194	- 11	- 158	- 31	- 37	- 433	- 612		- 78				- 126	- 51	- 866	- 1 299
5	Finance, real, busin.		- 4	- 1	- 6	- 6	- 3	- 19	- 7			- 2			- 4	- 2	- 14	- 34
6	Other services					- 1	- 2	- 4	- 53		- 199						- 252	- 256
7	Total	- 11	- 572	- 37	- 235	- 45	- 65	- 965	- 916		- 279	- 33		- 3	- 237	- 105	- 1 573	- 2 538
	Non-deductible VAT																	
1	Products of agricult.						5	5	217			1					219	224
2	Products of industry	2	3	3	22	92	731	853	8 249		344	780	9				9 382	10 234
3	Construction work					99	137	236	164			1 316					1 480	1 716
4	Trade, hotel, transp.					48	98	146	2 626		27	5					2 658	2 805
5	Finance, real, busin.					249	247	496	599			249					848	1 344
6	Other services					24	32	56	455				6				461	517
7	Total	2	3	3	23	511	1 250	1 792	12 311		371	2 351	14				15 048	16 840
	Trade and transport margins																	
1	Products of agricult.	165	587	4	133	2	13	904	928			3		3	51	15	999	1 903
2	Products of industry	313	4 782	1 421	2 039	450	956	9 961	17 250		917	4 694	1	105	1 953	1 300	26 220	36 181
3	Construction work																	
4	Trade, hotel, transp.	- 478	- 5 369	- 1 425	- 2 172	- 451	- 970	- 10 866	- 18 177		- 917	- 4 697	- 1	- 108	- 2 004	- 1 315	- 27 219	- 38 085
5	Finance, real, busin.																	
6	Other services																	
7	Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Taxes less subsidies on products																	
1	Products of agricult.	- 5	- 245		- 42		- 3	- 295	79			1		- 1	- 35	- 11	34	- 262
2	Products of industry	107	552	168	803	247	1 042	2 917	11 728		346	1 055	9	1	- 53	- 15	13 071	15 988
3	Construction work			- 1		97	137	233	164			1 308					1 471	1 704
4	Trade, hotel, transp.	- 2	- 189	- 10	- 139	18	62	- 259	2 177		- 50	5			- 126	- 51	1 955	1 696
5	Finance, real, busin.	6	73	11	113	312	277	791	1 235			702			- 4	- 2	1 931	2 722
6	Other services		12	2	12	62	38	127	916		- 198		6				724	850
7	Total	106	202	169	747	737	1 552	3 514	16 299		98	3 071	15		- 218	- 79	19 186	22 699

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As shown in the chapter on balancing, it is preferable to deal with all the balancing in one step and to balance the supply and use of margins, of product taxes/subsidies, of the other products in a simultaneous approach. Whether done in practice simultaneously or step by step, the supply of trade and transport margins must equal the use, and furthermore, the relation between the use data at purchasers' prices must be plausible when compared to the use data at basic prices.

Having elaborated matrix 6.4, the next step is to deduct the trade and transport margins from each single entry in the use table. Furthermore, it is necessary to reallocate the deducted trade and transport margins to the specific trade and transport service products distinguished in the product classification applied.

Similarly, a use-side matrix on product taxes less subsides also has to be estimated. The layout of this table is equal to that of the use-side trade and transport margin matrix as can be seen in Table 6.4. This table shows the amount of product taxes less subsidies included in the purchasers' price. For the estimation of these data, the relations between the value or the physical quantity and the tax rate of the specific product will have to be used.

The matrices for taxes and subsidies on products will be the result of single calculations for each of the product taxes/ subsidies. Contrary to the trade and transport margins, no specific information on distribution channels or transport deliveries is needed here; only the relation between the product and the tax/subsidy connected to it needs to be identified. However, for the estimation of table 6.5, some detailed supplementary calculations may be needed as the products that are taxed might only be a part of the product group distinguished at the classification level applied (see also Chapter 2).

The taxes less subsidies on products allocated at the use-side to be deducted from the purchasers' prices must of course be equal to the taxes less subsidies on products received by the government and measured on an accrual basis. The amounts of product taxes received and product subsidies paid by the government form the "supply" of product taxes and product subsidies as shown in column (13) of table 6.1.

Table 6.5: Use table at basic prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES (NACE)							FINAL USES									Total use at purchasers' prices
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exportsextra EU FOB	Total	
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	1 544	3 762	26	392	9	84	5 817	1 554		176	103		240	381	108	2 562	8 380
2	Products of industry	1 258	49 687	7 623	11 201	3 005	5 732	78 506	26 456		848	16 483	153	685	40 331	25 276	110 231	188 737
3	Construction work	99	542	1 993	951	3 598	1 308	8 492	868			19 453			429	280	21 030	29 521
4	Trade, hotel, transport services	563	9 978	1 837	13 439	1 754	2 400	29 971	42 586		1 295	4 758	1	108	5 415	3 589	57 752	87 723
5	Financial, real estate, business services	165	7 327	1 721	10 377	21 498	4 342	45 430	20 921		195	3 553		- 24	3 610	2 347	30 601	76 032
6	Other services	102	1 310	76	801	1 620	3 014	6 922	8 591	3 670	37 185	251	55		187	90	50 030	56 952
7	Total at basic prices	3 731	72 606	13 276	37 161	31 484	16 880	175 138	100 975	3 670	39 699	44 600	209	1 009	50 353	31 690	272 206	447 344
8	Taxes less subsidies on products	106	202	169	747	737	1 552	3 514	16 299		98	3 071	15		- 218	- 79	19 186	22 699
9	CIF/FOB adjustments on exports														- 133	- 30	- 163	- 163
10	Direct purchases abroad by residents								8 157								8 157	8 157
11	Domestic purchases. by non-residents								- 12 360						9 528	2 832		
12	Total at purchasers' prices	3 837	72 808	13 445	37 907	32 221	18 433	178 652	113 071	3 670	39 797	47 672	224	1 009	59 530	34 413	299 386	478 037
13	Compensation of employees	504	25 517	8 298	26 129	14 458	32 269	107 174										
14	Other net taxes on production	- 906	908	345	981	883	810	3 021										
15	Consumption of fixed capital	1 520	6 407	1 007	6 634	9 363	4 642	29 574										
16	Operating surplus, net	2 709	11 705	5 501	13 036	10 561	859	44 370										
17	Value added at basic prices	3 826	44 536	15 152	46 779	35 265	38 580	184 138										
18	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790										

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Similarly to the cases of trade and transport margins, the calculations of taxes less subsidies on products may also start from the use-side and the amounts of product taxes/subsidies by products then shifted to the supply-side. However, as explained above, the amounts of product taxes/subsidies identified at the use-side needs to be equal to the respective payments/ expenditures in the government accounts, not only in total but for each kind of product tax/subsidy. So, it is recommended first to clarify for each product tax/subsidy the amounts related and enter this data into column (6) of table 6.1.

There is, however, one type of product tax for which it is usually not possible to start at the supply-side, and this refers to non-deductible VAT. Of course, government revenues on total VAT would be available, but not by type of products. The structuring of VAT by products has to be estimated from the use-side by identifying all user categories not exempted to deduct VAT and to apply the appropriate tax rate to all their purchases of products.

Having estimated Table 6.5, the data have to be deducted from the use-data at purchasers' prices and shown as a separate row in the use table (concerning VAT see chapter 6.5).

After these steps, the use table has been transformed into a valuation at basic prices, the same valuation concept as in the supply table. Table 6.6 illustrates the resulting use table. In table 6.6, the trade and transport margins have been deducted and are shown here under the specific trade and transport products (CPA 50, 51, 52, etc.). Note that the product flows - now valued at basic prices - still do not distinguish between domestic and imported products. The elaboration of the import matrices is explained in chapter 9.

The estimation of the trade and transport margins is thus an important step in the compilation of supply and use tables. The amounts involved are of great magnitude, especially concerning the trade margins. The data situation for compiling the valuation matrices is often quite poor. Thus, plausible assumptions have to be made. Also, it might be advisable to make benchmark estimates for a year with a favourable data situation which then could be used for subsequent years.

The valuation matrices are not only an inevitable part of the matrices to be estimated in a supply and use framework, but they are also strongly related to the product data to which they pertain. The compilation of the valuation matrices has to be integrated in the total elaboration process and specifically also in the balancing procedure.

6.3 Trade margins

Wholesalers and retailers actually buy and sell goods. However, the goods purchased are not treated as part of their intermediate consumption in case they are resold with only minimal processing such as grading, cleaning and packaging. Wholesalers and retailers are treated as supplying services. Their output is measured by the total value of the trade margins realised on the goods they purchase for resale.

6.3.1 Definition and kinds of trade margins

The ESA 1995 defines a trade margin as:

> *A trade margin is the difference between the actual or imputed price realised on a good purchased for resale and the price that would have to be paid by the distributor to replace the good at the time it is sold or otherwise disposed of. By convention, holding gains and losses are not included in the trade margin. However, in practice, data sources may not allow to separate out all the holding gains and losses. Trade margins are valued at basic prices.*

The concept of trade margins can thus be applied to single goods, to trading activities of a statistical unit, to trading activities of industries and to total trading activities of the economy.

In practice, trade margins are derived as the difference between the trading sales and the costs of goods purchased for resale adjusted by changes in stocks (if possible, adjusted by holding gains and losses):

Trade sales (at basic prices)
- Costs of goods purchased for resale (at purchasers' prices)
- Trading stock at the beginning of the period (at purchasers' prices)
+ Trading stock at the end of the period (at purchasers' prices)
= Trade margin (at basic prices)

In order to derive trade margins, either for single goods, industries or the total economy, data on trading sales (trade turnover), data on goods purchased for resale and trading stock at the beginning and at the end of the period must be available. Usually, structural business statistics or specific trade surveys do deliver such data at the level of industries. However, trading is also an important secondary activity of nearly all industries.

Trading activities in the system are measured by trade margins, regardless whether done by traders as their main activity or by other industries as part of their secondary outputs.

Trading is defined as resale of goods without any transformation. However, certain operations (manipulations) associated with trade are included in the definition of trading, such as the sorting, mixing, breaking bulk and re-packaging for distribution in smaller lots. Also included may be other services if not separately invoiced such as installation in situ.

Trade services are usually distinguished between wholesale and retail sale. Wholesale is the re-sale (sale without transformation) of new and used goods to retailers, industrial, commercial, institutional or professional users, or to other wholesalers. Retailing is re-sale (sale without transformation) of new and used goods, mainly to the general public for personal or household consumption or utilisation. This distinction is important with respect to the allocation of the trade margins to the use categories. However, this distinction is not always easy to observe.

When trade margins are derived from structural business statistics or similar sources they include trade services which are not to be considered as trade margins. This is valid for the trade services on used goods, waste and scrap. Also trade services where a domestic enterprise buys goods in a foreign country A and sells them to foreign country B are not to be considered as part of the trade margins as these margins are not part of the difference between supply and use of goods. These trade services (transit trade) have to be treated as service exports.

Because of the valuation concepts of imports (CIF), no imports of trade margins need to be considered.

6.3.2 Compilation of trade margin matrices

Some countries collect data from annual business surveys covering margins by type of product earned by wholesalers, retailers and motor traders, and the total purchases and sales of traded goods and services for all other industries. However, in many cases trade margins for products are not available from surveys.

Supply-side trade margin matrices

As already mentioned above, due to availability of data sources, one might start the compilation of the trade margin matrices either from the supply side or from the use side. Starting from the use side means that estimates are made on the share of trade margins included in each element of the use table at purchasers' prices. Such shares depend on the typical product margin ratios and the share of the use flow delivered via the trade channels. Normally, such information cannot be gathered by asking enterprises and other users as they might only have information on the last step in the distribution channel (where they have bought the product), but clearly not on the steps earlier, and even for this last step they do not know the margin ratio implicitly invoiced to them. Thus, plausible assumptions both on the margin ratios and on the share of purchases via distributive channels will have to be made.

It seems, therefore, quite logical to start the compilation with the supply side resulting in data on the total amount of trade margins by products produced by all domestic industries. At least structural business statistics or special trade surveys will provide data on total trade margins by industries which need then to be transformed into data by products. Starting at the supply side also allows checking the assumptions made when the product-flow method has been used for estimating or checking use data. Lastly, also in the case of benchmark estimates, it is advisable to calculate the full range of supply and use-side trade margin matrices by exploiting all available data sources and thus to lay a basis for subsequent calculation rounds. Needless to repeat, that supply and use of trade margins by products must be equal at the end.

Data on trade margins produced by products are usually not available from surveys. If this were the case, these data could directly be entered into the supply table. Of course, adjustments for holding gains and losses would have to be made and also any additions to ensure full coverage of trade margin supply because of under-reporting, hidden economy, and similar national accounts adjustments. In most cases, only data by industries are surveyed without a breakdown by products and/or by wholesale and retail trade.

The data usually available are such that total trade margins by industries can be derived: namely trade turnover, total value of goods purchased for resale and changes in trading stocks. It has to be checked whether the data available cover all industries as trading is an activity carried out in almost all industries. If this is not the case, specific estimates have to be made. It might, for instance, be the case that for certain industries only total output is known without distinguishing between trade output and other output. In such cases estimates based on plausible assumptions should be made to achieve data on total trade margins of the economy. Trading is also an important secondary output in many service industries other than trade, from barber shops to museums, from hotels to recreational and sporting industries.

In order to transform trade margins by industries into trade margins by products, it is necessary to subdivide the trade margins by each industry into the trade margins by products considering the range and share of products traded and the margin ratios connected to each product. Furthermore, it is necessary to subdivide the trade margins into wholesale and retail trade margins. It is obvious that this transformation cannot be done in one step as information is not directly available. In this transformation one would need both the shares of the goods traded as well as the typical margin ratios of each product and the shares of wholesale and retail trade for each good. It is therefore recommended to do it in a stepwise procedure and to start with the trade turnover.

Trade turnover (revenue) data by industries are the starting data to derive trade margins by industries. Such data are available at least for those industries which are covered by the structural business statistics. The first step would be to separate trade revenues into wholesale trade turnover and retail sale trade turnover. In structural business statistics a distinction between wholesale and retail trade turnover is often surveyed in the trade industries, but not in the other industries. However, even in cases where trade turnover has to be reported separately for wholesale and for retail, the value of products purchased for resale may not be required to be distinguished between wholesale and retail sale. Thus, trade margins by industries subdivided into wholesale and retail trade margins cannot be derived on the basis of such survey data directly.

Any industry can produce both wholesale and retail sale services. This is valid for trade industries as well as for all other industries. Whether such cases are important normally depends on the kind of industry.

The subdivision of trade revenues into wholesale and retail trade turnover has to be done by using plausible assumptions if no survey-based data are available. For example, one can assume that trade turnover of restaurants and hotels will probably be retail trade turnover, the same with trade turnover of hairdressers, cinemas and theatres. On the other hand, trade activities of advertising agents will more likely be wholesale trade. In manufacturing the situation is more complex as in many industries the trade activity covers both wholesale and retail trade, but the bulk of trade activities there will probably be of the wholesale type. Manufacturing industries trade in similar products that are also produced by them or in complementary products and such trade sales will usually be of a wholesale type. These industries are also importers of such products which will also be normally classified as wholesale trade. On the other hand, there are industries where a grouping by size might be relevant for the adequate allocation of the type of trade performed. To take the bakery industry as an example: the trade of small bakeries is normally retail sale type, whereas the trade of the larger ones is probably wholesale type.

The distinction between wholesale and retail trade is relevant for all industries, even if for some industries only wholesale or retail trade may occur in practice. Wholesale industries are classified in the industry classification NACE Rev. 1 under division 51, retail industries under division 52. However, it should be noted that division 51 covers also commission trade which is not part of the trade margins. Furthermore it has to be noted that division 50 "Sale, maintenance and repair of motor vehicles and motorcycles (including parts and accessories), and retail sale of automotive fuel" is a mixture of both wholesale and retail trade activities as well as of non-trade activities, and has to be dealt with appropriately.

The second step is then the subdivision of the trade turnover by products which would result in two trade turnover matrices industries by products, one for wholesale trade turnover and one for retail trade turnover (Table 6.6). The likely data sources for this step are usually also very poor. It might be the case that for the trade industries such data are surveyed, but not for the other industries. Here again, plausible assumptions are needed. It would not be wrong to assume that, for instance, for hairdresser trade in cosmetic articles, hotels trade in souvenirs, newspapers, journals, food and beverages, and museums trade in books, multimedia products, and so on. However, the share of each product group still has to be estimated. The general rule is also valid here that working at a certain detailed level gives plausible results in the aggregates, even if only rudimentary information is available.

Estimating trade turnover by products is for some industries a difficult task. This is valid for many branches in the trade industries where usually a lot of goods are traded, such as in the non-specialised trade, but also in some specialised trade branches. On the other hand, there are some branches where one can easily make plausible assumptions on the trade pattern, such as the retail sale with shoes, where surely about 80 - 90% of the turnover will be turnover with shoes, the rest with textiles, accessories for shoes, cleaning preparations and the like. Clearly, it is more easy to make some estimates for retail branches compared to wholesale branches as the first ones are better known from everyday life and more homogeneous (with the exception of supermarkets and other non-specialised retail trades). Furthermore, one can try to get some data from the trade chains which – because of the computerisation of their commercial activities – actually have detailed information on the goods traded.

Table 6.6: Trade turnover matrices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	INDUSTRIES (NACE)						Total
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	
No		1	2	3	4	5	6	7
1	Products of agriculture	Wholesale trade turnover						Total by product
2	Products of industry							
3	Construction work							
4	Trade, hotel, transport services							
5	Financial, real estate, business							
6	Other services							
7	Total	Total wholesale trade turnover by industry						
1	Products of agriculture	Retail trade turnover						Total by product
2	Products of industry							
3	Construction work							
4	Trade, hotel, transport services							
5	Financial, real estate, business							
6	Other services							
7	Total	Total retail trade turnover by industry						

The wholesale branches are usually more difficult because of the higher level of heterogeneity. Of course there are branches with a clear concentration on one or a few product groups, such as the wholesale of motor vehicles, the wholesale of crude petroleum, and some others. On the other hand there are branches with very broad groups of products traded and others with a high level of specialisation. This makes it more difficult to achieve plausible estimates and some single pieces of information on specific units may not be representative for the total branch. Also, in manufacturing, it will be difficult to estimate trade turnover structures by goods traded without any information as the specialisation can also be very high. Again, one can try to get some information by asking selected units with significant trade turnovers.

Having compiled the two trade turnover matrices, one can check the trade turnover with the supply of the goods (domestic production and imports) as well as the relationship between wholesale and retail trade turnover. These relationships will vary between products, especially between consumer, intermediate and capital goods. Such checks should ensure that the trade turnover estimated is in some plausible relation to the supply of the goods. So, for instance, there should be not much retail trade turnover of intermediate and capital goods, wholesale trade turnover should normally not be much higher than domestic production plus imports (plus wholesale margins), retail trade turnover of consumer goods should not be much higher than household expenditure of these goods. However, there may be exceptions to these general rules for certain products. This, for example, would be the case when a product is traded twice within the same chain of distribution. This might be the case in wholesale when imports are performed by one wholesaler and then sold to another (regional) wholesaler.

Having established trade turnover matrices, the next step is to transform these data into margin data. This could be done by multiplying the trade turnover matrix by the assumed product margin ratios. Margin ratios are defined here as the share of a trade margin in relation to the trade turnover. Such margin ratios can be defined at the level of products (product groups) or at the level of industries which would give information on the average margin of that industry.

In transforming the trade turnover matrices, we have in principle two options: we either can apply for each industry the average margin ratio of that specific industry to all the products traded or we can apply a specific product margin ratio to all trade turnover of that product irrespective of the industry. The first approach uses the idea of the industry technology and the second one that of the product technology. Thus, the question to be discussed is which of the alternatives is the best approximation to reality. Of course, one has also to take into account the wholesale and retail trade distinction.

If one is analysing trade data, one would see that obviously margin ratios differ between wholesale and retail and also within wholesale and retail between the different trade branches. Taking retail trade branches as examples, usually the margin ratios of petrol stations are much lower than margin ratios of the food and beverage trade branch, those of cosmetic articles and pharmaceuticals are higher than those of household articles, and so on. Normally, wholesale trade margin ratios are smaller than the corresponding retail sale margin ratios. If the typical margin ratios differs between the trade branches and the trade branches have their specific trade pattern, one can conclude that obviously trade margin ratios are strongly connected with the goods traded. Thus, the assumption of product specific margin ratios seems to be more adequate for the transformation of the turnover matrices.

Thus, the next step is to explore sources for product specific margin ratios, both for wholesale and for retail sale. One possible source might be to compare and relate the prices observed in the consumer price index (adjusted by VAT) and in the wholesale trade price index, if available. For comparable and representative goods one could derive a typical retail product margin ratio. The same could be done by using price data of production price index and compare them with wholesale price index information, which would provide proxies for wholesale margin ratios. In case of regulated prices, the price levels in the different distribution channels could also be used. It is clear that all such sources might not be comprehensive enough and the comparison work might also be very laborious.

A much easier way is to use the margin ratios of the single trade branches as proxies for the product margin ratios. So, one could use the margin ratio of the retail trade branch with shoes as the typical retail margin for shoes. This would easily be possible for trade industries which are defined by the products traded (specialised trade) and where one product group dominates. Of course, one would need trade branches data at a detailed level.

Having established a set of product specific margin ratios, the multiplication of the trade turnover matrix could then be performed on the assumption that these product specific margin ratios are valid in all industries trading that product. The next step would be to compare the resulting wholesale and retail trade margins by industries (summed up over the products and the wholesale and retail trading) with the surveyed (or estimated) trade margins by industries. Ideally there should be no difference between these two sums. However, there will be some differences. The reasons for differences could be errors in the trade turnover matrix, in the subdivision between wholesale and retail trading, in the assumed or derived product margin ratios and in the fact that the assumption of the "product technology" may not be correct.

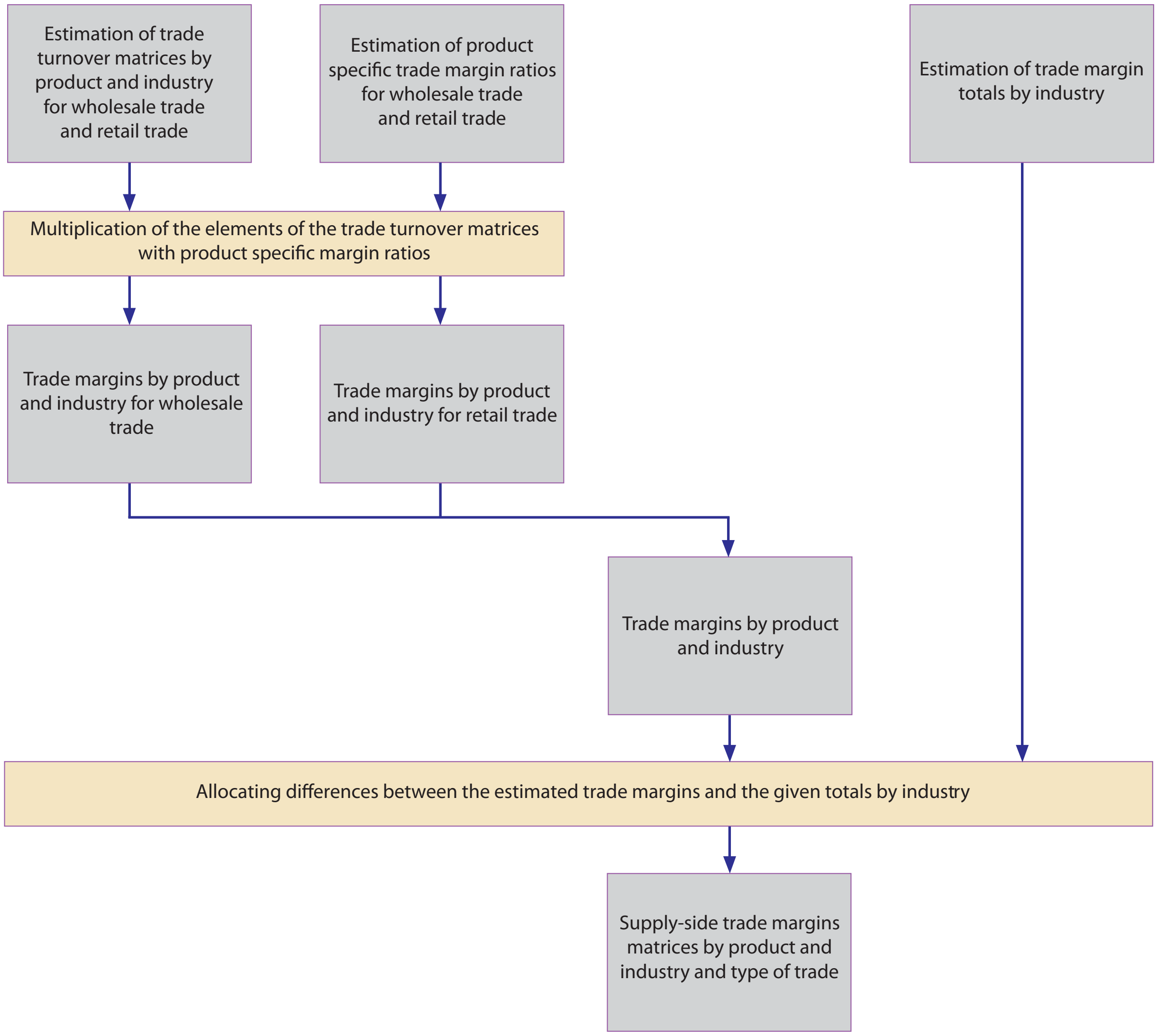
The differences should be analysed and adequate changes in the data be implemented. The goal would be to minimise the difference and thus to best approximate the estimated trading pattern of each industry to the given totals. In certain industries the assumption of product specific trade ratios might not be valid. One example could be mail order businesses whose average margin ratio might be much higher than in the specialised trade branches. Here the difference between the estimated margin and the given totals might be quite high, indicating that the basic assumption might be wrong.

It is the task of the compiler of the trade margin matrices to check the data and the assumptions made. In the end, there will be a certain amount of difference left, which then should be allocated to the products on a pro-rata basis, so that the estimated trade margins are equal to the given totals by industries. In doing so, the hierarchy of the product specific margin ratios is ensured, even if the absolute levels (see mail-order business example) differ between industries.

Figure 6.2 summarises the estimation steps needed to arrive at supply-side trade margin matrices. It should not be neglected that in these steps of compiling supply-side trade margin matrices, a lot of uncertainties will have to be dealt with. This has to do with the usually weak data sources but also with the tremendous changes in the trade industries, both with respect to changing forms of supply of trade services, the ongoing concentration in retail trade branches, the increase in the size of shops, as well as with the increasing importance of internet trade, and many more reasons. Furthermore, the magnitudes of trade margins are extremely high. For certain products trade margins could be up to more than 100 % of total supply at basic prices.

Despite these uncertainties, the estimation procedure as explained here has some important advantages: it allows checking trade turnover by products as well as trade margins by products with the supply of these products; it also supports the product-flow estimates by taking the size of the total trade margins by products, the distributive channels as well as the assumed margin ratios into account. This compilation method should thus be followed as much as possible depending on the data sources, or at least for a benchmark calculation.

Figure 6.2: The compilation process of supply-side trade margins



It should be remembered that in these trade margin matrices only those trade margins that form the difference between use at purchasers' prices and supply at basic prices should be included. Trade services in second-hand goods, scrap and waste or similar commodities not considered as products should be treated separately. Also, the transit trade services need to be separated.

Use-side trade margin matrices

In order to transform the use table from purchasers' prices into basic prices, deducting the trade and transport margins as well as the net product taxes is necessary. This subchapter deals with the calculation of the use-side trade margin matrices as shown in Table 6.4. These matrices show the amount of trade margins by products and industries and final uses.

Data availability for use-side matrices seems to be even worse than for the supply-side matrices, due to the simple fact that buyers of the goods do not know the share of the trade margins in the price they have to pay. Sometimes they even do not know whether they have bought from a trader or not. Only in the obvious cases that the buyer has bought in a retail shop or at a wholesale trader does the buyer know that the price paid includes some trade margin, without knowing the amount of the incorporated margin. All the distribution channels before the final seller are certainly completely unknown to the buyer.

The calculation of the use-side trade margin matrices has to be based on plausible assumptions and balanced with the estimated total supply of the trade margins. Ideally, the following types of information might be necessary:

- for each single element of the use table the share of the purchases that has been bought via trade (for all involved steps in the distributive channel);
- the relevant margin ratios of the products.

The unknown component is clearly the distributive channel. It could also be that the margin ratio of certain products varies between users. Here plausible assumptions have to be made. Also, the distinction between wholesale and retail trade comes into play. As explained, this distinction concerns neither the size of the margin ratios nor quantity of the products traded; rather, it refers to the type of the buyer of the trade service (broad distinction between industries and consumers).

It could be assumed that in intermediate consumption mostly wholesale trade margins are involved and very few retail trade margins (such as buying stationery materials by handicrafts, smaller shops and small scale enterprises). On the other hand, one can assume that most of the retail margins may be allocated to private consumption expenditures, with also some exceptions, when consumers have access to the wholesale channel directly. Of course, a certain part of the consumer expenditures on goods may not involve trading services at all, when directly bought from the producer of the good (e.g. bakeries, tailors, etc.). Concerning the wholesale services connected with private consumption, the situation might differ a great deal. Some of the products bought in retail trade may have been delivered from wholesalers, but others directly from the producers of the goods.

Similar considerations may be undertaken for capital formation, for which the wholesale channel is most important, and to a very small extent, also the retail sale channel (e.g. valuables, smaller equipment).

In inventories only, wholesale margins can be involved but not retail sale margins. Furthermore, wholesale trade margins can only be allocated to input stocks and trading stocks, but clearly not to output stocks. Changes in inventories over the accounting period are the result of the stock at the beginning and additions and withdrawals during the accounting period. There should be no allocation of trade margins to the stocks of the beginning of the period as only trade margins produced during the period should be allocated, but not trade margins produced in previous years. Thus, trade margins can be allocated to additions to stocks. On the other hand, withdrawals from the same accounting period are increases of intermediate inputs or of final uses. In the case of withdrawals, the products are thus shifted from stocks to "real" uses and together with the products also the margins.

For exports, one can assume that only wholesale margins are involved and, with some exceptions, the majority relating to goods bought by non-resident travellers (tourists). If VAT statistics are available, one can base the estimates on the turnover data of the exports reported by the trade industry. This would not cover trade of goods in exports by industries other than trade.

Some other more general considerations relate to the share of imports (i.e. imported goods are more likely to be bought via wholesale trade), the size of the enterprises in the different industries (i.e. small enterprises may more likely buy certain goods also via retail trade), and the like.

The allocation of the trade margins to the single use elements will have to be done in a step-by-step procedure, starting with the flows for which the best quality information is given or the assumptions seem to be of most plausible character. In this first step, the margins calculated in product-flows will also be utilised as well as information given from VAT statistics. After this step, those margins/use elements will be allocated which can only be based on assumptions. For all these steps the total supply of trade margins from the supply-side calculations forms the constraints.

In all these steps, the details available from the supply-side should be utilised as much as possible; this especially refers to the details of products. The resulting use-side trade margin matrices should also be checked on overall plausibility, both with regard to the relationship between allocated wholesale and retail trade margins as well as concerning the relations between the use data at purchasers' prices and the allocated trade margins. It could be the case that based on such checks, the supply-side margin data will also have to be changed.

Having achieved final use-side trade margin matrices, these matrices have to be deducted from the use matrices at purchasers' prices and the margin values for each industry and final use category aggregated and allocated to the trade margin products according to the product classifications. The wholesale trade margins have to be allocated to CPA division 51 and the retail sale margins to division 52. However, wholesale and retail trade margins on motor vehicles and motorcycles (for both including parts and accessories) as well as retail trade margins on automotive fuel have to be allocated to CPA division 50. It is thus advisable to separate these trade margins in the whole compilation process as best as possible.

6.4 Transport margins

6.4.1 Definition and kinds of transport margins

Aside from the trade margins, transport margins are another valuation component relating to the delivery chain of the products from the producer to the final user. Transport margins represent freight transportation services of products when invoiced separately by the seller. Transport margins are defined as follows:

> *Transport margins are the transport costs for transportation of products paid separately by the purchaser and included in the use of products at purchasers' prices but not in the basic price of a manufacturers' output or in the trade margins of wholesalers or retail traders.*

Such transport margins include in particular:

- transport of goods from the place where it is manufactured or sold to the place where the purchaser takes delivery of it in case the manufacturer or trader pays a third party for the transport, if this amount is invoiced separately to the purchaser;
- transport of goods arranged by the manufacturer or by the wholesale or retail trader in such a way that the purchaser has to pay separately for the transport costs even when the transport is done by the manufacturer or the wholesale or retail trader himself.

This definition of transport margins implies that the transportation has to be arranged by the seller (producer or trader). This also implies that transportation arranged directly by the purchaser (and thus, of course, also directly paid for by the purchaser) is not included in the transport margins.

The definition of the transport margins is thus related to the way the transportation costs are paid. This means that transport margins cannot be derived from the output of the respective transportation services, information of the payments between the two related parties of the seller and the buyer is required. This definition of transport margins in the ESA 1995 is thus much more restricted than the former system as it also included the transport costs paid by the seller. However, in the old system transportation costs paid by the seller were not to be included in its output.

Both the old and the new definitions are consistent since only those transport services that form part of the difference in the valuation of supply and use are regarded as transport margins. The new treatment may be considered as being more in line with the bookkeeping of the firms, but makes the elaboration of the transport margins more difficult.

Based on this basic definition, all the following transportation costs are not recorded as transport margins, because they do not contribute to the valuation difference between basic prices and purchasers' prices:

- if the manufacturer or trader transports the goods himself, and does not invoice the transportation separately, these transportation costs will be included in the basic price of the manufacturer's or trader's output; this transport represents an ancillary activity and the individual costs of transport will not be identifiable as transportation costs;
- if the manufacturer arranges for the goods to be transported without a separate invoice for the transport services, these transport costs will be included in the basic prices of the manufacturer's output; these transportation costs will be identifiable as such and be recorded as part of the manufacturer's intermediate consumption;

- if wholesale and retail traders arrange for goods to be moved from where they take delivery of them to where another purchaser takes delivery, these costs will be included in the trade margin if no separate charge is made for transportation to the purchaser (i.e. these costs will be part of the intermediate consumption of the wholesale and retail traders);
- if a household buys goods for final consumption purposes and arranges for transport by a third party, these transport costs are recorded as final consumption expenditure on transport services and not included in transport margin;
- if a domestic carrier transports goods form country A to country B through the domestic territory (transit transport), this will also not be considered as a transport margin as it does not relate to goods that forms part of domestic supply and use; these transportation services will be recorded under exports of services;
- also, transportation services of domestic carriers outside domestic territory are not part of the transport margins, but exports of services;
- freight transportation of used goods, scrap and waste, earth and similar freight connected with construction projects are also not part of transport margins as these goods are not considered as products. This includes also transportation of goods in connection with removals.

As explained above, the definition of transport margins in the ESA 1995 excludes the case when the purchaser directly arranges and pays the transportation. Here, the important question is of course in which way the transportation costs are treated in the business accounts and thus in the source data. If the cost of transportation that is arranged by the purchaser were included in the price of the intermediate inputs or final use in the source data, then obviously they should also be treated as transport margins, but if they are recorded as a separate cost item, they should not be treated as transport margins. Thus, to some extent the recording of transportation costs in the source data may have influence on the actual coverage of transport margins, if the source data were not adapted to be in line with the restricted ESA definition. However, such adaptations seem not to be feasible unless when made in the process of the compilation of the transport margins. Thus, it may be questioned why such adaptations should be done at all, when the end result would equally be data at basic prices.

Contrary to the trade margins there could also be imported transport margins when a foreign carrier transports freight into, within, or out of the domestic territory. This would especially be the case of road, sea (inland waterways), and air transport. In the case of railway freight, foreign carriers cannot currently use the domestic railway system; also, pipelines within the domestic territory are normally run by a resident enterprise.

According to the modes of transport, several kinds of transport margins have to be distinguished. In addition, the services of forwarding agencies also form part of the transport margins when paid separately by the buyer. Last, but not least, transport insurance services have also to be considered under the same terms as the general definition of transport margins. Transport insurance services have to be recorded analogously to the other insurance services, namely, based on the service charge concept.

In total, the following kinds of transport margins have to be taken into account:

- road
- railway
- water
- air
- pipeline
- forwarding
- transport insurance

Compared to the trade margins, the transport margins are of a much lower magnitude and are, according to the definition in the ESA 1995, much lower than they were before in the old system. However, the complexity of the transport margin is much bigger, not only because of the different kinds of margins, but also because of the definition itself. Furthermore, the data situation gives rise to many practical elaboration problems. The relationship between the supply of goods and the transport margins connected with them is looser than in the case of trade margins. Several reasons can be given for this: transport costs are usually not related to the value of the goods transported, much transportation is done as ancillary activity; and, the way transportation costs are paid might differ from product to product and from transaction to transaction.

6.4.2 Compilation of transport margin matrices

Supply-side transport margins

Similarly to the case of trade margin matrices, it is recommended to start the transport margin matrices also with some supply-side calculations for the same reasons: there is no direct information on the amount of transport margins included in the purchasers' prices and a comprehensive estimation of the transport margins in an economy may be used as benchmark data for other years as well.

Starting from the supply-side involves firstly the identification of the transport services added on to goods in the different industries. As shown in the subchapter above, not all of these transport services will be regarded as transport margins for the following reasons: there are transport services on goods not considered as products in the system such as the transport of used goods (including removal services), of scrap and waste, of earth and similar goods in relation to construction projects. A second reason relates to transit transport where a domestic carrier transports goods from a foreign country A to a foreign country B. Thirdly, all transportation outside the domestic territory in connection with imports and exports of goods are to be considered as transport services, but not as transport margins. Only those transport services that contribute to the difference between the supply of products at basic prices and the use of products at purchasers' prices are to be treated as transport margins.

Furthermore, according to ESA 1995 definitions, the transport margins are given even less coverage compared to the old system since transport costs are only part of the purchasers' price if the purchaser has to pay for them separately. If the seller pays for the transportation and does not invoice it to the buyer separately, these transportation costs have to be shown as part of the intermediate consumption of the seller. Thus, only in the case that the seller arranges for the transportation and invoices it to the purchaser separately, these transportation costs form part of the difference between supply at basic prices and use at purchasers' prices and are thus to be entered in the transport margins matrices.

It would have to be explored whether the separate invoicing of transportation costs by the seller is of great importance. Of course, it will exist, but for simplicity one could argue that in reality these cases are of less importance and conclude that there are no transport margins at all.

If we do not apply this extreme assumption, the calculation of the transport margins according to the ESA 1995 is a complicated task. From the supply-side alone we are not able to distinguish between transport services paid for by the seller from those – only relevant – transport services invoiced to the purchaser. Starting from the output of transport services in the different industries, only the total transport service can be calculated. From this total output we have to deduct the transport revenues related to transit transport, transport outside domestic territory, transport revenues related to freight not considered as products, and last but not least transport revenues paid for by the seller not invoiced separately and those directly paid for by the purchaser. Furthermore, we have to subdivide the resulting transport margins by products and by mode of transport.

Usually, information on freight transportation revenues not to be considered as transport margins as well as information on products transported is not available in monetary terms. Structural business statistics will only provide us with total revenue data. One possibility is to make use of transportation statistics which normally survey transportation activities in physical terms by providing data on the transport distance, whether domestic, cross-border or transit transport, the transport volume in terms of weight and tonne-kilometres and the kinds of goods transported. Transportation statistics may also cover all the different modes of transport (road, railway, water, air, and pipeline).

The use of such transportation statistics could thus be a source to achieve estimates on these unknown components. The data on tonne-kilometres will have to be multiplied with appropriate transport tariffs (transport prices). Such tariffs will vary between the goods transported as different kinds of transport vehicles have to be used. Transport tariffs do also vary according to the transport distance.

The transformation of the physical transport volumes into monetary revenues by using the transport tariff information has to be checked with the total output of relevant transport revenues. There will be differences between these two totals and the estimated transport revenues by products will have to be aligned to the transport revenues surveyed in structural business statistics. The reasons for such differences are weak data, under-reporting of transport statistics, inadequate assumptions concerning the actual transport tariffs.

Utilising transport statistics information would ideally result in supply-side data on transport services which includes transport services paid for by the seller as well as by the buyer. A separation of these two components can only be made by using information on the use-side (i.e. transport costs paid for by the seller). Transport statistics also support the estimation of the value of transit transport and transportation outside domestic territory connected with imports and exports. Furthermore, transportation statistics can also be used to estimate the imports of transportation services (i.e. transportation services provided by foreign carriers in the domestic territory). One would have to assume that the same transport tariffs are also valid for the foreign carriers.

Transportation costs are usually surveyed in structural business statistics, at least as one separate cost item. By definition these transportation costs relate to the goods produced or traded. Based on the structure of the output and the products traded an estimate can be made on the structure of the products for which the transportation costs have been paid for. At least, one can assume that the transport costs are to some extent proportional to the value of the products produced or traded. However, this is a very implausible assumption and the estimate will be of poor quality.

However, such a poor estimate will have to be used to compare the transport costs paid by the purchaser with the total transport services of the supply-side. Conceptually, the transport costs invoiced separately to the purchaser have to be deducted from total transport services as calculated on the basis of transportation statistics in order to achieve an estimate on total transport margins by products. Because of the uncertainties in all the data entered into these calculations and the assumptions to be made, the results might not be directly usable for the further calculations. However, this approach makes best use of the data sources that are available. This approach – if feasible at all – seems more important to follow if the basic data for transport costs directly paid for by the purchaser are recorded together with the products purchased and thus included in the purchasers' prices.

As far as possible the various estimation steps to calculate the transport margins matrices should be separated by the different modes of transport. Firstly, the available data might be quite different and different estimation methods need to be applied. Secondly, one could try to ask for additional data (for instance from the national railway company). Thirdly, the spectrum of freight is also quite different (for instance, compare pipeline with railway). Fourthly, the differentiation by modes of transport also helps to build the correct relations between the supplier and the user of the products. Lastly, even at the two digit-level of CPA, a differentiation between land, water, and air is necessary.

The magnitude of the transport margins and even of the total transport services is much smaller than that of the trade margins. In some cases, the imbalance between supply and use of a product might be much bigger than the transport margins of that specific product, however estimated. One could thus consider concentrating on those products where important transportation services are involved. Such products are normally agricultural and forestry products, energy products, iron and steel products and products related to construction. However, this may vary between countries.

For the forwarding agents' services, we have the same elaboration problems as for the transportation itself. However, the forwarding agents' services are much more related to the transportation costs and estimates could be based on the structure of the transportation margins. However, not all transportation is organised by forwarding agents. Forwarding agents are usually engaged in cross-border transportation rather than in domestic transportation. In evaluating the practical problems connected with the correct estimates of forwarding agents' margin matrices, one could consider treating these services as not being part of the transport margins but as normal products.

Transport insurance services are usually a very small part of the transport margins. Here also, they may be more important for cross-border transportation than for domestic transportation. A main difference is that the insurance premiums depend on the value of the goods transported rather than on actual transport costs of the freight. Similarly to the forwarding agents' services, and in view of practical implementation and the usually small magnitude of such services, for transport insurance services one could again consider treating them also as normal products outside the margin system.

Use-side transport margins

The calculation of the use-side transport margin matrices has to deal with the same uncertainties concerning available data and estimation problems as those on the supply-side. Of course, transport services of transit transportation and transport services outside domestic territory can easily be entered into the export column under transport services and the transport margins related to exports allocated to the specific export products.

The allocation of the transport margins to the use data will have to be based on plausible assumptions starting from the supply of transport margins. The estimation of the transport costs paid for by the seller can only marginally be used as an indication of the allocation of transport margins. One cannot assume that an allocation should not take place neither to users that have reported a certain amount of transport costs paid by themselves at all nor to any product that the user has in its intermediate consumption. Only part of the transport costs may have been paid for by the purchaser and only for certain inputs.

Because of the weak database one may concentrate on the products with large transport margins involved and allocate the remaining products according to some plausible assumptions. As only a part of all transport services are transport margins it is thus also difficult to check the resulting data on plausibility. Of course, supply and use of transport margins should be equal, but the estimation of the one side is not independent from the estimation of the other side (if both approaches have been applied in the first place).

Having achieved the final use-side transport margin matrices, these matrices have to be deducted from the use matrices at purchasers' prices and the total margins by industry and final uses be allocated to the transport services of the product classification: railway, road and pipeline to CPA division 60, water to division 61, air to division 62, forwarding to division 63, and transport insurance to division 66.

Cross-border transportation services

As explained in the preceding chapters, the complexities in the elaboration of the transport margin matrices stem from the following:

- generally weak database,
- not all freight transportation output is to be considered as transport service,
- the definition of transport margins are based on the criteria of who pays for it,
- cross-border transportation.

According to the ESA 1995, imports and exports of goods are to be valued free on board (FOB) at the border of the exporting country. However, for the supply and use system imports can still be valued CIF and an appropriate adjustment item should serve for the transition between both valuation concepts. A CIF-valuation means that transport costs up to the border of the importing country are included in the CIF-value.

Transport services between the border of the importing country and the domestic location of the buyer are thus to be considered as transport margins (if paid for by the buyer or separately invoiced by the seller). Analogously, transport services between the domestic location of the seller and the border in the case of exports are also to be considered as transport margins (if paid for by the buyer or separately invoiced by the seller). Transportation services outside domestic territory are never to be considered as transport margins, but are imports or exports of other services.

Transport services crossing the border can be provided by resident carriers as well as by non-resident carriers. Resident carriers can also provide transportation services for resident or non-resident buyers involving transportation services totally outside domestic territory (transit transportation). Such transportation services are always transport services, but not part of the transport margins (exports of services if the buyer is a non-resident unit). Non-resident carriers can also provide transportation services within domestic territory for resident or non-resident buyers. Such transportation services are to be considered as transport margins, as they contribute to the valuation difference between supply and use (imported transport margins). These different situations are summarised in Table 6.7.

Table 6.7: Use-side transport margins

	Domestic territory	Outside domestic territory
EXPORTS OF GOODS		
Resident carrier	Domestic transport margin	Export of services
Non-resident carrier	Imported transport margin	----
IMPORTS OF GOODS		
Resident carrier	Domestic transport margin	Export of services
Non-resident carrier	Imported transport margin	(included in CIF)

6.5 Taxes and subsidies on products

A tax on a product is a tax that is payable per unit of some good or services. The tax may be a specific amount of money per unit of quantity of a goods or services (e.g. mineral oil tax), or it may be calculated ad valorem as a specified percentage of the price per unit of value of the goods and services transacted (e.g. value added tax). A subsidy on a product is a subsidy payable per unit of output of a good or service. The subsidy may be a specific amount of money per unit of quantity of the good or services, or it may be calculated ad valorem as a specific percentage of the price per unit.

6.5.1 Definition of taxes and subsidies on products

Taxes less subsidies on products are the other valuation component in addition to the trade and transport margins. Compared to them, the elaboration of the matrices of product taxes/subsidies is less complicated and the data situation is also usually more favourable. The definition of product taxes/subsidies is of general national accounts importance and not just an aspect of the supply and use framework. The main task of the supply and use tables compilation work with regard to the product taxes/subsidies is to create the relation between the different kinds of taxes/subsidies and the product flows. The classification of the single taxes/subsidies of a country to the categories of taxes/subsidies according to the ESA 1995 as well as data on the amounts of each single product tax/subsidy can be taken as given.

The attribution of each single product tax/subsidy to the respective product items is therefore the first compilation step which directly results in column (13) in Table 6.1. The second step is to attribute the product taxes/subsidies to the respective use data at purchasers' prices, and then to deduct the taxes less subsidies from the use data. A further specific task relates to VAT: calculations also have to be made here regarding non-deductible VAT.

The ESA 1995 defines product taxes and product subsidies as follows:

> *Taxes on products are taxes that are payable per unit of some good or service produced or transacted. The tax may be a specific amount of money per unit of quantity of a good or service, or it may be calculated ad valorem as a specific percentage of the price per unit or value of the goods and services produced or transacted. – As a general principle, taxes, in fact assessed on a product, irrespective of which institutional unit pays the tax, are to be included in taxes on products, unless specifically included in another heading.*
>
> *Subsidies on products are subsidies payable per unit of a good or service produced or imported. The subsidy may be a specific amount of money per unit of quantity of a good or service, or it may be calculated ad valorem as a specific percentage of the price per unit. A subsidy may also be calculated as the difference between a specified target price and the market price actually paid by the buyer. A subsidy on a product become payable when the good is produced, sold, or imported. By convention, subsidies on products can only pertain to market output or to output for own final use.*

The ESA 1995 distinguishes three types of product taxes:

- value added type taxes,
- taxes and duties on imports excluding VAT,
- taxes on products, except VAT and import taxes.

For all these different types of product taxes the ESA 1995 gives further definitions and lists typical examples. It should be noted that the ESA 1995 also treats profits of fiscal monopolies which are transferred to the State as product taxes.

Taxes should be recorded when the activities, transactions or other events occur which create the liabilities to pay taxes. The amounts to be recorded in the system are determined by the amounts due for payment only when evidenced by tax assessments, declarations or other instruments which create liabilities in the form of clear obligations on the part of taxpayers. The system does not impute missing taxes not evidenced by tax assessments. Subsidies are recorded when the transaction or the event (production, sale, import, etc.) which gives rise to the subsidy occurs. Thus, the system requires that the taxes/subsidies are recorded at the time of the causing transaction or event. Therefore tax revenue data have only to be time adjusted (due to be paid); no imputations of taxes because of any kind of tax evasion need to be calculated.

6.5.2 Compilation of product tax and subsidy matrices

The first compilation requirement refers to the column (13) vector of Table 6.1. The product taxes less product subsidies are shown by products. This step necessitates classifying the different product taxes/subsidies according to the product classification used. Mineral oil taxes will be attributed to CPA division 23, tobacco tax to division 16, and so on, or to the appropriate more detailed level of the classification in use. The same has to be done for the product subsidies.

As mentioned above, the amounts of the different product taxes/subsidies can be taken from the respective government revenues and need to be time-adjusted (due to be paid). No further compilation steps would be needed to arrive at the required column of product taxes less subsidies for the supply matrix at purchasers' prices (column (13) of Table 6.1).

However, in cases where the basic output data of the industries are not available at basic prices but at producers' prices only, specific calculations have to be done to attribute the respective taxes/subsidies to the output elements of the supply matrix and to deduct these values from the output data at producers' prices. These calculations have to be based on the actual taxation basis of each single product tax according to the tax legislation. The same has to be done for the product subsidies.

The second compilation step with respect to the product taxes and subsidies refers to the allocation of the product taxes and subsidies at the use side (intermediate use and final uses) at purchasers' prices to achieve Table 6.4. For those product categories for which product taxes/subsidies have been allocated the share of the tax/subsidy component in the purchaser price has to be calculated. This step needs to be based on the appropriate taxation basis according to tax legislation. Of course, Table 6.4 is the result of the appropriate calculations for each single kind of taxes and subsidies on products.

In order to adequately allocate the product taxes/subsidies to the use elements, not only the appropriate tax rates have to be explored but also the share of the use flows at which the tax rate is to be applied. A certain product classification category might not only include flows that are taxed but also other types of products not taxed, and/or certain products may be free of taxes for certain users. For instance, the mineral oil tax may not only have different tax rates for the different mineral oil products, also some of them might have a tax rate of zero (aviation fuel) and some users might be tax exempted (agriculture). Therefore, the allocation of the product taxes/subsidies would be easier if it would be possible to compile the supply and use framework at a level of product detail where a one-to-one relation between the product classification item and the product taxes/subsidies would be given. Furthermore, in cases that product taxes/subsidies are linked to the physical quantities, such additional information might be necessary.

On the other hand, it can be noted that usually product taxes/subsidies are restricted to only a small group of products, and furthermore, quite a few product taxes cover the bulk of them. This is even more the case with product subsidies.

A specific product tax is the Value Added Tax (VAT). According to the ESA 1995, VAT is to be recorded net in the sense that

- output of goods and services and imports are valued excluding invoiced VAT,
- and that purchases of goods and services are recorded inclusive of non-deductible VAT. VAT is recorded as being borne by the purchasers, not sellers, and then only by those purchasers who are not able to deduct it.

Thus, the greater part of VAT is therefore recorded as being paid on final uses, mainly on household consumption. A part of VAT, however, is paid by enterprises and other institutions, namely by those which are exempted from VAT.

According to the definition of purchasers' prices, non-deductible VAT is included in the purchaser price, but not deductible VAT. Thus, the use table at purchasers' prices (see Table 6.3) includes non-deductible VAT. In order to balance supply and use, non-deductible VAT by products has to be estimated and either included in column (13) of Table 6.1 or – more preferably – be deducted from the use table. After balancing non-deductible VAT, supply and use has to be recalculated based on the balanced data.

The calculation of non-deductible VAT has to identify those industries and final users that are exempted from VAT (= are not allowed to deduct VAT from their purchases) and to relate the VAT rates to the product classification used. Both steps need to be based on the actual VAT legislation. Usually, there are only two or three different VAT rates valid. However, some product items in the product classification applied might be heterogeneous with regard to the VAT tax rates. Thus, additional breakdowns of those product groups might be necessary. By far the largest allocation of non-deductible VAT has to be made for final consumption expenditure by households as VAT is a tax on private consumption. Among industries, some smaller service sectors and investors are not allowed to deduct VAT from their purchases.

The identification of the activities that are VAT exempted is the other requirement. Here again, only a certain part of an industry might be VAT exempted and appropriate subdivisions might be helpful. It could also be the case that certain VAT exempted industries are normal VAT payers for their secondary outputs. The VAT legislation may also have specific rules for very small enterprises that have to be considered (thresholds).

It should also be considered that purchases of non-residents recorded under exports also include non-deductible VAT (if no VAT reimbursements have been granted). On the other hand, purchases of residents abroad, recorded under household consumption, do not include domestic VAT.

It is important to note that for VAT exempted industries, non-deductible VAT has to be calculated both for intermediate consumption as well as for capital formation (and if appropriate for inventories also). Total calculated non-deductible VAT should equal time adjusted VAT revenues by government.

VAT included in the accounts reflects cash collected on an accrued basis. The supply and use tables allow the estimation of theoretical VAT based on the use-side and the effective VAT rates. However VAT in the supply and use system needs to be constrained to cash collected estimate of actual VAT. The missing VAT is not included in the accounts.

As shown in Chapter 6.2.2 the transformation from purchasers' prices to basic prices involves deducting trade and transport margins as well as product taxes less subsidies. The preferable sequence of these steps is: non-deductible VAT, other taxes and subsidies on products, trade margins and transport margins.

Import matrices

chapter 7

eurostat

7.1 Introduction

The supply of goods and services comprises the supply of domestic products and imported products. This chapter deals with estimating the use table for imports. It is compiled in order to separate the use of imported goods and services from the use of domestic goods and services. The import matrices have therefore the same dimension as the use tables shown in Chapter 5. The intermediate use part of the import matrix shows the use of imported goods and services by product and industry in production. The final demand part of the import matrix shows the use of imported goods and services by categories of final use.

Figure 7.1: Compilation of import matrices

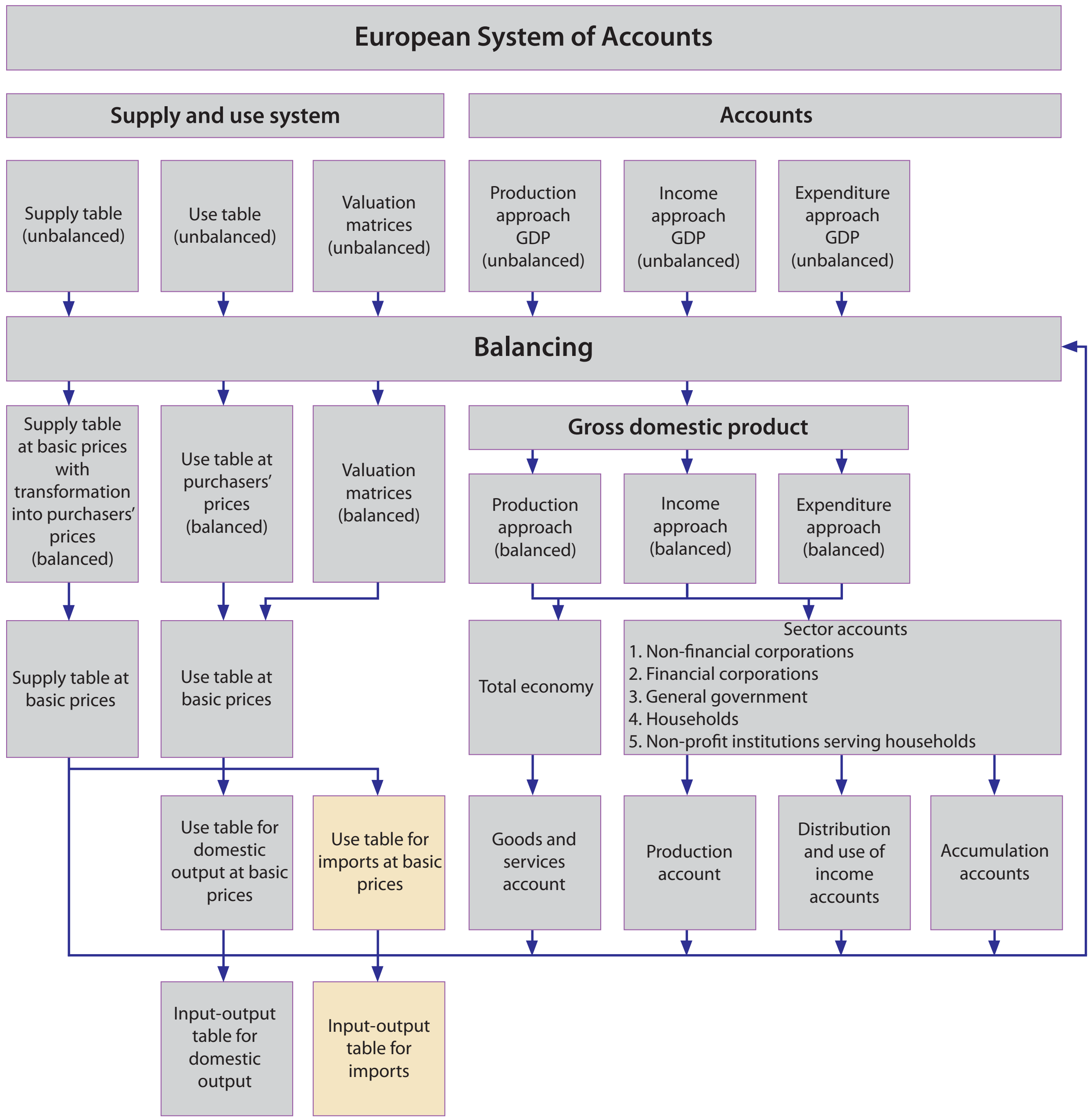


Figure 7.1 demonstrates how the compilation of import matrices is embedded into the system of national accounts. With the globalisation of economic activities, exports and imports are growing more rapidly than GDP. The value added chains

in production are becoming more complex and more international. Therefore, it is very important for the national accounts to provide sectored disaggregation of macroeconomic data for both domestic production and imports. A supply and use system with detailed information on exports and imports is an integral part of the European System of Accounts. For balancing supply and demand and deflating GDP, supply and use tables at basic prices are the best option.

Ideally the set of supply and use tables at basic prices includes the following tables:

- Supply table at basic prices
- Use table for domestic output at basic prices
- Use table for imports at basic prices

The separation of domestically-produced and imported goods and services is of great importance for analytical purposes. This information is necessary for all types of analysis where the link between supply and use of domestic goods and services within the national economy plays a role. The input-output framework of the ESA 1995 therefore also contains a use table for imported products and a use table for domestically-produced goods and services as well as symmetric input-output tables for domestic production and imports. The separation of imports of goods and services and domestically produced goods and services is of great importance not just for analytical purposes but also for balancing of the national accounts and for deflating GDP on the basis of supply and use tables.

The use table of imports will serve as the basis for the derivation of the symmetric input-output table of imports. This topic will be covered in Chapter 11 (Transformation of supply and use tables to symmetric input-output tables).

The set of symmetric input-output tables at basic prices includes the following tables:

- Input-output table at basic prices
- Input-output table for domestic output at basic prices
- Input-output table for imports at basic prices

The use table of imports may not necessarily be seen as a core feature of the supply and use framework. It could be argued that, for analytical purposes, it is only required to compile a symmetric input-output table for the imports using the symmetric input-output table as a starting point. However, there are also arguments in favour of the compilation of the use table of imports. One argument is that the compilation can be based on rectangular supply and use tables and, consequently, will provide a much better specification of the use of imports because of the much higher degree of product detail. Another valid argument is that for compiling supply and use tables at constant prices, separating the use table into a use table for domestic output and a use table for imports is useful. Similarly, a separation between domestic and imported products is helpful for the balancing procedure which will be discussed in Chapter 8 (Balancing supply and use). Last but not least, the use table of imports can be transformed into a symmetric input-output table for imports, so that the efforts undertaken for the compilation of the use table of imports are not in vain. Furthermore, the compilation methods described in this chapter for the different forms of import matrices are principally the same.

Direct information for compiling the use table for imported products will be rare and is available only in exceptional cases. Thus, direct information has to be supplemented by reasonable assumptions. Working on a highly detailed level of product groups is therefore usually the better option. A detailed level helps identify the likely users of a specific imported product.

Increased international division of labour and international trade among Member States and between Member States and non-Member States resulted in high increases of imports and exports both of goods and of services. The import share of certain products and also in total has thus increased considerably. Also, imports (and exports) in smaller countries are of relatively higher importance than in bigger ones.

In Chapter 4 (The supply table) of this manual, a detailed description of the concepts and definition of imports has already been given. Therefore, these issues are not repeated here. In the supply chapter, emphasis is placed on the imports by products as part of total supply. In the supply table, imports are only shown as a vector of products covering goods and services. However, it is envisaged for the supply table to subdivide the import vector by regions separating intra EU imports and extra EU imports.

Like in nearly all chapters of this manual, there are close links to other chapters. One important link – as already mentioned – is to Chapter 4 (The supply table). Imports as shown in the supply table form the numerical basis for the allocation of the imports to the single use categories. Another important relationship is with Chapter 5 (The use table) where the concepts of intermediate and final use are described implicitly, covering all domestic and imported goods and services. There is a further link to Chapter 6 (Valuation matrices) where the imported transport margins are explained. Also, Chapter 8 (Balancing supply and use) needs to be mentioned as the estimation of the use table of imports may affect the already balanced supply and use data.

7.2 Imports in the supply and use framework

Imports consist of purchases of goods and services by residents from non-residents. They include also barter, receipts of gifts or grants. In the system, total imports are valued FOB. However, data on detailed flows of imports from foreign trade statistics are most usually valued at CIF prices. To reconcile the different valuation used for total imports and the product components of imports, a global CIF/FOB adjustment on imports is added.

7.2.1 Definition of imports

The concepts and definitions of imports according to the ESA 1995 are described in detail in the Chapter 4 (The supply table). This is also valid for the definition and practical time of recording and the valuation of imports. The supply chapter also describes the main problems connected with the compilation of the supply of imports (data sources, coverage, etc.).

For our considerations concerning the use tables of imports, the explanations given in the supply chapter are a starting point both in terms of concepts and definitions as well as in data. For the use table of imports, the supply of imports shown in the supply table has to be allocated to the different use categories of intermediate and final uses.

7.2.2 Use tables of imports

Table 7.1 shows the use table for imports as part of the supply and use system. The table shows the use of the imported goods and services by products and by industries and final use categories. An empirical example of a use table of imports is given in Table 7.2. In the columns the table has the same format as the use table. It distinguishes two main submatrices, one for the intermediate use and one for the final uses of products. The total use of imports (column 17) must be equal to the total supply of imports as shown in the supply table. This equality is given for each of the products distinguished in the supply and use system.

Table 7.1: Use table for imports

<table>
<tr><th rowspan="2"></th><th rowspan="2">INDUSTRIES (NACE) / PRODUCTS (CPA)</th><th colspan="7">INDUSTRIES (NACE)</th><th colspan="9">FINAL USES</th><th rowspan="2">Total use at basic prices</th></tr>
<tr><th>Agriculture</th><th>Industry</th><th>Construction</th><th>Trade, hotel, transport</th><th>Finance, real estate, business</th><th>Other service activities</th><th>Total</th><th>Final consumption expenditure by households</th><th>Final consumption expenditure by non-profit organisations</th><th>Final consumption expenditure by government</th><th>Gross fixed capital formation</th><th>Changes in valuables</th><th>Changes in inventories</th><th>Exports intra EU FOB</th><th>Exports extra EU FOB</th><th>Total</th></tr>
<tr><td>No</td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td></tr>
<tr><td>1</td><td>Products of agriculture</td><td colspan="6" rowspan="6">Imported products for intermediate consumption at c.i.f. values</td><td rowspan="6">Imported intermediates</td><td colspan="8" rowspan="6">Imported products for final uses at c.i.f. values</td><td rowspan="6">Imported final uses</td><td rowspan="6">Imported total uses</td></tr>
<tr><td>2</td><td>Products of industry</td></tr>
<tr><td>3</td><td>Construction work</td></tr>
<tr><td>4</td><td>Trade, hotel, transport</td></tr>
<tr><td>5</td><td>Financial, real, business</td></tr>
<tr><td>6</td><td>Other services</td></tr>
<tr><td>7</td><td>Total at basic prices</td><td colspan="6">Intermediate consumption by industry</td><td></td><td colspan="8">Final uses by category</td><td></td><td></td></tr>
</table>

= Import vector of the supply table

If the use table of imports is subtracted from the use table at purchasers' prices, the corresponding use table for domestic output can be derived which shows only domestic products. However, a further step is to subtract and reallocate the trade and transport margins and to deduct the taxes less subsidies on products in order to achieve the final supply and use system at basic prices.

Table 7.2: Empirical example of a use table for imports

	INDUSTRIES (NACE) / PRODUCTS (CPA)	INDUSTRIES (NACE)							FINAL USES									
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at basic prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	199	1025	7	26	1	4	1 261	629			14		9			652	1 912
2	Products of industry	402	30 153	3 218	4 348	678	2 102	40 902	14 563	749		11 363	74	169	2 459	2 533	31 911	72 812
3	Construction work			360				360										360
4	Trade, hotel, transport	5	493	25	2 882	42	69	3 516	22	1		7			7	4	41	3 557
5	Financial, real, business	10	605	152	953	2 675	341	4 735				338					338	5 073
6	Other services		526		10	95	183	813					27				27	840
7	Total at basic prices	616	32 801	3 762	8 218	3 491	2 699	51 587	15 214	750		11 722	101	178	2 466	2 537	32 968	84 554

Austria 2000

= Import vector of the supply table

Table 7.3 shows an empirical example of an input-output table for imports at basic prices. Please note that the submatrices for final uses and the row totals for products are the same in the use table of imports and the input-output table of imports.

Table 7.3: Empirical example of an input-output table for imports at basic prices

	BRANCHES / PRODUCTS (CPA)	HOMOGENEOUS BRANCHES							FINAL USES									
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at basic prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	161	1 004	16	64	11	5	1261	629			14		9			652	1 912
2	Products of industry	328	28 787	3 361	5 122	1 218	2 086	40 902	14 563	749		11 363	74	169	2 459	2 533	31 911	72 812
3	Construction work		8	345	5	3		360										360
4	Trade, hotel, transport	4	531	34	2 772	104	70	3 516	22	1		7			7	4	41	3 557
5	Financial, real, business	8	611	160	928	2 696	333	4 735				338					338	5 073
6	Other services		519	1	17	98	178	813					27				27	840
7	Total at basic prices	501	31 459	3 916	8 908	4 130	2 672	51 587	15 214	750		11 722	101	178	2 466	2 537	32 968	84 554

Austria 2000

= Import column vector of the supply table

= Import row vector vector of the input-output table

The analytical potential would be enhanced if the use table of imports also showed supplementary classifications, such as a distinction between competitive and complementary imports, or imports subdivided by regions, such as a separation of imports coming from intra EU or extra EU. Competitive imports are products that are also domestically produced whereas complementary imports are products that are not domestically produced. This distinction is of analytical interest as both types of imports can be expected to have a different relationship with and importance for the national economy. Competitive imports can be the subject of economic analysis concerning substitution policies and effects. Complementary imports, as products not being produced in the national economy, are sometimes vital and analyses may focus on the impact of changes in their prices or volume.

In theory the distinction between competitive and complementary imports seems to be clear. However, in practice a number of borderline cases have to be solved. For the validity of this distinction, the product level of disaggregation is of utmost importance. Even on a very detailed product level it is sometimes very difficult to classify the products as competitive or complementary. Furthermore, this classification may not be stable over time.

Because of these practical difficulties, the experience of countries which tried to implement such a distinction in their national supply and use framework is not very encouraging. Furthermore, the large increase in inter-industry trade due to globalisation in the last decades may have reduced the interest in such a distinction, perhaps with the exemptions of certain mining or energy products. However, it should be noted that the ESA 1995 does not require the compilation of import matrices which distinguish competitive and complementary imports.

Compared to the distinction between competitive and complementary imports, a geographical breakdown of the use table of imports is easier to compile as there may be data problems but no basic conceptual problems. Usually for the goods, information on the geographical origin of the imports is available in foreign trade statistics. For services, the data situation concerning the geographical breakdown of imports is less favourable.

The main problem in compiling use tables on imports with a geographical breakdown is how to allocate a single product imported from two geographical regions to the respective use categories: should one allocate it proportionally to the assumed users? However, similar questions already arise when compiling the use table of imports without geographical breakdowns: is the import share of an imported product the same in all use categories? In consequence, a geographical breakdown might need such additional assumptions in order to allocate the imports.

Table 7.4: Input-output table for domestic output at basic prices

	BRANCHES / PRODUCTS (CPA)	HOMOGENEOUS BRANCHES							FINAL USES									Total use at basic prices
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	Domestic products for intermediate consumption at basic prces							Domestic products for final uses at basic prices									Output
2	Products of industry																	
3	Construction work																	
4	Trade, hotel, transport																	
5	Financial, real, business																	
6	Other services																	
7	Total at basic prices								Final uses at basic prices									
8	Use of imported products, CIF	Imported intermediates							Imported final uses									
9	Taxes less subsidies on products	Net taxes on products for intermediate consumption							Net taxes on products for final use									
10	Total at purchasers' prices								Final uses at purchasers' prices									
11	Compensation of employees	Components of value added																
12	Other net taxes on production																	
13	Consumption of fixed capital																	
14	Operating surplus, net																	
15	Value added at basic prices																	
16	Output at basic prices	Output																

= Row vector of the input-output table of imports

No distinction between competitive and complementary imports is part of the current data delivery programme for the European System of Accounts. But the new ESA 1995 transmission programme contains two sorts of geographical breakdown (voluntary in both cases); the split of imports and exports on members and non-members of the European Union and on members and non-members of the Economic and Monetary Union. Eurostat intends, and has done so in the past, to compile aggregate supply and use tables and aggregate input-output tables for the European Union. These aggregate tables are based on an assessment of separate import matrices for EU and non-EU imports in the national supply and use systems. An even more ambitious goal is the compilation of multi-regional input-output tables for the European Union with the Member States as the regions. This table would clearly need to distinguish imports and exports of each country from all of the other Member States and from non-Member States.

A use table of imports is also necessary to compile symmetric input-output tables. Table 7.3 shows such an input-output table of imports. The only difference from the use table of imports in Table 7.2 is that Table 7.3 shows the intermediate use of the imports in a product by product format. The final use part is unchanged. The derivation of the symmetric input-output table of imports is not discussed here. Chapter 11 (Transformation of supply and use tables to symmetric input-output tables) will discuss how use tables of imports can be transformed to symmetric input-output tables of imports.

Having also transformed the use table of imports into the product by product dimension, the final input-output system has been created, as shown in Table 7.4. This table shows the symmetric input-output table for domestic output and is the basis for input-output analyses. It should be noted that in this table the use of imported goods and services is only shown in an aggregated form in one row. The corresponding empirical example is presented in Table 7.5.

Table 7.5: Empirical example of an input-output table for domestic output at basic prices

No	BRANCHES / PRODUCTS (CPA)	HOMOGENEOUS BRANCHES: Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total	FINAL USES: Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at basic prices
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	1 199	2 721	40	480	33	83	4 557	925	176		90		231	381	108	1 911	6 467
2	Products of industry	699	19 100	4 485	7 017	2 717	3 586	37 604	11 892	99		5 119	78	516	37 872	22 743	78 320	115 925
3	Construction work	81	592	1 580	962	3 640	1 277	8 131	868			19 453			429	280	21 030	29 161
4	Trade, hotel, transport	456	9 455	1 891	10 255	2 093	2 304	26 455	42 564	1 294		4 751	1	108	5 407	3 584	57 710	84 164
5	Financial, real, business	129	6 811	1 615	9 163	19 047	3 932	40 696	20 921	195		3 215		-24	3 611	2 348	30 265	70 961
6	Other services	82	802	88	802	1565	2 771	6 109	8 591	37 185	3 670	251	29		187	90	50 003	56 112
7	Total at basic prices	2 645	39 481	9 699	28 678	29 096	13 952	123 552	85 761	38 949	3 670	32 879	108	832	47 887	29 153	239 238	362 790
8	Use of imported products, CIF	501	31 459	3 916	8 908	4 130	2 672	51 587	15 214	750		11 722	101	178	2 466	2 537	32 968	84 554
9	Taxes less subsidies on products	87	231	181	725	768	1 522	3 513	16 299	98		3 071	15		-218	-79	19 186	22 699
10	Total at purchasers' prices	3 233	71 170	13 796	38 310	33 994	18 147	178 652	117 274	39 797	3 670	47 672	224	1 009	50 135	31 611	291 392	470 043
11	Compensation of employees	427	25 444	8 424	25 632	15 498	31 750	107 174										
12	Other net taxes on production	-728	781	323	925	916	803	3 021										
13	Consumption of fixed capital	1 238	6 518	1 154	6 524	9 594	4 546	29 574										
14	Operating surplus, net	2 297	12 012	5 463	12 773	10 959	866	44 370										
15	Value added at basic prices	3 234	44 754	15 364	45 854	36 966	37 965	184 138										
16	Output at basic prices	6 467	115 925	29 161	84 164	70 961	56 112	362 790										

Austria 2000

= Row vector of the input-output table of imports

7.3 Compilation of the use table of imports

The compilation of the use table of imports is not an easy task, as often primary sources are not available. However, in a large rectangular supply and use system many homogenous products can be identified which have to be imported from abroad. In so far, the allocation of goods and services in the use table for domestic output and the use table for imports is easier if a large rectangular supply and use system is available.

7.3.1 The general approach

Direct information on the use of imported goods and services by industries is usually only available in exceptional cases. In most cases the elaboration of this matrix needs to be based on some realistic assumptions and indirect estimation methods. This is also true for the final demand part of the use table. Only in cases where certain products are obviously only imported and not domestically produced can one directly draw a conclusion as to the respective use of these imports.

Box 7.1: Intrastat system - statistics relating to the trading of goods between Member States

In March 2004 the European Parliament and the Council adopted a new regulation on Community statistics relating to the trade of goods between Member States. This regulation makes the unprecedented system of data collection which is currently in place (the Intrastat system) more transparent and easier to understand.

Intrastat, which has been in operation since 1993, is the system for the provision of statistical information on dispatches and arrivals of Community goods. The provision of statistics is essential for the development of Community policies on the internal market and for Community enterprises to analyse their specific markets.

In order to simplify the current Intrastat system and make it easier to understand the statistics, this regulation establishes a common framework for the systematic provision of Community statistics relating to the trade of goods between Member States. It applies to the statistics on trade between Member States for the dispatches and arrivals of goods. Different rules may apply to specific goods or movements.

For the Intrastat system, customs authorities provide national authorities with statistics on dispatches and arrivals of goods. The national authorities collect the following data:

- the identification number allocated to the party responsible for providing information;
- the reference period;
- the flow (arrival, dispatch);
- the commodity;
- the value of the goods;
- the quantity of the goods;
- the partner Member State and
- the nature of the transaction.

The Member States decide on their own ways of supplying the Intrastat data. The task of the parties supplying this information can be simplified by the use of automatic data processing and electronic data transmission. Each month, Member States provide Eurostat with results which cover their total trade of goods in electronic form.

Intrastat

Information on the imports by products as well as by the importer is available in the Intrastat system and can also be utilised in this exercise to some extent (Box 7.1). However, there are certain problems related with this type of information:

- A first problem is created by the fact that in the Intrastat system the reporting unit is the enterprise rather than the local KAU. The local KAU should be the unit for the supply and use tables.
- A second problem is the fact that intermediate consumption should be recorded in the use table at the time the products enter the process of production. The imports are recorded at the time of the changes of ownership between the resident buyer and the non-resident seller.
- Another problem is that certain goods imported by manufacturing enterprises can be used for intermediate consumption or for capital formation. Even if it is possible to distinguish between intermediate goods and capital goods on the basis of the character of the good, an enterprise may also import a typical capital good for intermediate consumption.
- A fourth and quantitatively more important problem is that a lot of imports are undertaken by traders who, of course, are not the final users of the imported products. Furthermore, one must consider that non-trade enterprises may import goods in order to trade with them in their secondary activities.

It is obvious from this list of problems that information from the Intrastat system can only be partially used. Furthermore, Intrastat provides only data on imports from intra-EU trade; for imports from outside the EU, there is the customs based information system where a link to the industry of the importers is usually not available. Another restriction is that Intrastat covers only goods, and not services.

Box 7.2: The Combined Nomenclature

When declared to customs in the Community, goods must generally be classified according to the Combined Nomenclature, or CN. Imported and exported goods have to be declared stating under which subheading of the nomenclature they fall. This determines which rate of customs duty applies and how the goods are treated for statistical purposes.

The CN is a method for designating goods and merchandise which was established to meet, at one and the same time, the requirements both of the Common Customs Tariff and of the external trade statistics of the Community. The CN is also used in intra-Community trade statistics.

The CN is comprised of the Harmonised System (HS) nomenclature with further Community subdivisions. The Harmonised System is run by the World Customs Organisation (WCO). This systematic list of commodities forms the basis for international trade negotiations, and is applied by most trading nations.

Harmonised System (HS)

In 1984 the members of the World Customs Organisation (WCO) adopted the Harmonised Commodity Description and Coding Systems – more commonly referred to today as the Harmonised System or simply the HS. The system entered into operation at the beginning of 1988 and is currently used by more than 179 countries, as well as Customs or Economic Unions (there are 104 contracting parties to the HS Convention), and accounts for over 98% percent of world trade. It is therefore one of the most important instruments in world trade.

The HS comprises a standardised description of goods, classified into a number of different "sections", "chapters" and "categories" using a system of six to ten digit numbers. The system provides for up to 99 chapter headings, covering all goods from live animals to personal effects.

Statistics by product (Prodcom)

Prodcom is a system for the collection and dissemination of statistics on the production of manufactured goods. The title comes from the French "PRODuction COMmunautaire" (Community Production) for mining, quarrying and manufacturing: sections B and C of the Statistical Classification of Economy Activity in the European Union (NACE 2).

It is based on a product classification called the Prodcom List which consists of about 4500 headings relating to manufactured products.

- Products are detailed on an 8-digit level; 1 to 4 digits refer to the NACE classification in which producing enterprises are normally classified.
- Most headings correspond to one or more Combined Nomenclature (CN) codes.
- Some headings (mostly industrial services) do not correspond to a CN heading at all.

The Prodcom List, NACE, Statistical Classification of Products by Activity in the European Economic Community (CPA) and Combined Nomenclatures are available at Eurostat's metadata server.

For the goods and services recorded in the final use table, the situation is even worse regarding direct information on the use of imported products. This is especially true for the private consumption expenditure where such information is not available and even cannot be observed. Concerning gross capital formation and exports, the same applies as has been said concerning the use of Intrastat data above.

The Intrastat system provides information on the users of the imported goods which can at least partly be utilised. Unfortunately, there is normally no similar source of information for imported services available. Only in some countries are imports and exports of services surveyed directly at the importing and exporting enterprises. However, in such cases there are similar pitfalls as described above, with two exemptions: firstly, there is, of course, no trade of services as we have for goods, thus the importer of a service product is normally also the user of the service; secondly, the differences in the time of recording between the import and the actual use could be neglected in the case of services.

The use table of imports will thus have to be compiled on the basis of plausible assumptions depending on the character of the imported goods and services. From a theoretical point of view, the question arises as to whether imported products could be treated as fully homogeneous to domestically produced products. In this case, the user has no specific preferences whether a domestic or an imported product is purchased. This theoretical assumption might be accepted at the level of single products (valued at basic prices) where such a homogeneity from the point of the potential user could be assumed.

However, in practice we know that we are working at a statistical aggregate level and a proportional allocation of imports to the various uses would be misleading. Firstly, the import shares are not equal (for example the import share in exports will usually be quite lower), and secondly, the use data are valued at purchasers' prices including differing margin shares between uses and maybe also between domestic and imported products. A proportional allocation of the imports would thus be a method which is difficult to accept.

Combined Nomenclature (CN)

A crucial point is therefore the disaggregation level in the compilation of the use table of imports. The basic data for the imports of goods are available at the level of the Combined Nomenclature (CN) which is the most detailed product classification in EU statistics (Box 7.2). However, many of the subdivisions in the CN are of a pure customs nature and do not contribute to the problem of the allocation of imports. In the case that the use table would also be available at the level of the CN, according to our homogeneity assumption the compilation of the use table of imports would be very easy to make: one would proportionally distribute the imports of each CN element according to the use of this CN element over the different users (industries and final use categories).

In practice, however, the use tables are not available at such a detailed product level and it would not be acceptable to merely distribute the imports proportionally. This would mean that imported products will be allocated to users that have not used the specific product in intermediate or final consumption but other products which fall into the same product group are distinguished in the use table. Logically, a procedure has to be applied that takes into account the different imported products as much as possible, even if the use table does not distinguish at the same detailed level.

In practice, the following situation will be normal: the level of product detail in the use table might range from just 60 (division of CPA) to some hundreds or even a few thousand products. The level of detail for the imports of goods would still be much greater. However, due to the integrated classification system, the relations between the product level of foreign trade and the applied level detail in the use tables are of a "many to one" character. A certain number of CN elements correspond to each product group in the use tables.

The procedure must thus make assumptions on the use of each single imported product (CN or other appropriate level) within each product category as distinguished in the use table. The problem is that the share of the single imported product in the use elements is not known because of the higher aggregation level in the use table. Assumptions have to be made based on the character of the product.

Classification by Broad Economic Categories (BEC)

For this procedure, the BEC classification can be of some help. BEC categorizes the goods into the broad categories of intermediate goods, consumer goods and capital goods (Box 7.3). The elements of BEC are the subclasses of SITC which are defined in terms of the Harmonised System Codes (HS). However, the categories distinguished there are only of broad use categories and are of less help for the intermediate uses, still BEC would help achieve a certain categorisation of the products with respect to use.

Nevertheless, the main task would remain, namely to attribute allocation ratios and percentages for each category of imported products, on which the allocation of the imports to the assumed user will be based. Here, one must also take into account, that theoretically, a lot of products can be used by each type of user. For example, food products would mainly be used by private households, but also by restaurants, hospitals, etc.; household refrigerators may to a small extent also be used in gross fixed capital formation for convenience to the employees, etc.

For certain products the allocation is normally an easy task as there are products which may have very few users only (e.g. crude oil). Other products may be used in several industries or by private households only, while other products have a whole range of users. In defining the allocation percentages one has to consider that due to secondary output products are also used in industries where they might not be typical inputs into that industry.

Box 7.3: Classification by Broad Economic Categories (BEC)

The Classification by Broad Economic Categories (BEC) was introduced by the UN in the early 1970s. It was initially developed to reclassify merchandise imports into product categories relevant to the System of National Accounts (SNA). BEC is a three-digit classification that groups commodities according to their main end use, namely capital goods, intermediate goods and consumption goods. BEC was designed as a means for converting data compiled in terms of the Standard International Trade Classification (SITC), into end-use categories.

These categories are aligned as far as practicable with the System of National Accounts (SNA) framework. The BEC classification is suitable for the general economic analysis of international merchandise trade statistics, and for facilitates the use of this data in conjunction with other national and international economic statistics.

The BEC groups goods into nineteen basic economic categories. Sixteen of these basic categories make up the broad end-use categories: consumption goods, capital goods and intermediate goods. A fourth category (other goods) includes the three remaining basic economic categories, which have proven difficult to assign.

This exercise – if done for the first time – is certainly time consuming, but the allocation percentages can generally also be applied for other years without any big changes. Usually a great share of total imports will fall under quite a few headings of the product classification and efforts should be concentrated on those as they determine the quality of the resulting use table of imports to a large extent. Furthermore, experience shows that many of the products have only one or a few users in terms of industries. Clearly, such products can be handled more easily than products which are used in many or all industries.

A difficult category of final demand with respect to the allocation of imports is the changes in inventories. First of all, it has to be considered that the import share of semi-finished and finished products is zero. Secondly, the changes in inventories are a balancing item between the inventories at the end of the period minus the inventories at the beginning of the period without knowing the inflows and outflows over the period.

In calculating final use data, for certain products and for certain use categories (e.g. household consumption), the commodity-flow method may already have been used to allocate the use of products. In such a procedure, assumptions have already been made on the allocation of certain imports. Thus, it would be advisable to use the same assumptions again in the process of the calculation of the import matrix, as otherwise inconsistencies in the supply and use data system can result.

It is advisable to have the allocation procedure differentiate between the products with one or few users. In the first case, the use of imports can be assessed without great problems. In the second case, when the products have many users, the allocation is more difficult. In most cases a proportional allocation is now feasible. The main reason for such a differentiation is that in cases of proportional allocation all the imports that could be allocated easily should already be deducted from the use table before those products that can only be allocated proportionally are allocated. Otherwise the basis for the proportional allocation would still include the other products and thus give a distorted allocation basis.

From the discussion above it should be clear that it is advisable to base the estimation of the import matrices on a very detailed level of products. However, it is also clear that it is impossible to work at the level of the single CN elements. A practical working level could be the six-digits of CPA or the more detailed level of PRODCOM, or a level between both classifications. However, there still would be a great number of elements that cannot be viewed as homogeneous with respect to the allocation of the imports. On the other hand, many elements of those classification levels could be treated the same way in the compilation of the import matrices as they could be viewed as homogeneous with respect to use. It is difficult to make any more specific recommendations on the adequate product level for this exercise. This depends on the overall working level of the use tables but also on the structure of the imports. The more detailed the product classification used in the supply and use system is, the more acceptable it is to apply the import share of the product to separate the imports from domestic production in all uses.

In the process of balancing it must be expected that the procedure needs to be repeated in order to achieve plausible results. The allocation shares might be corrected as well as the industries or final use categories that have been considered in the allocation assumption. Clearly, basic indicators of implausible results are negative use elements if the imports are deducted from the use data (including the deduction of the margins and of the taxes less subsidies on products). Furthermore, an allocation of imports to a use element with a zero entry is not permissible. It would definitely result in negative elements in the use table for domestic products. Further plausibility checks could consider other likely non-entry elements. For example, many goods and services are quite unlikely to be used as capital formation, others quite unlikely to be used in intermediate consumption altogether or in certain industries.

Concerning imports of services, in principle the same procedure can be applied. However, the basic information on the imports of services is usually not available at a very detailed level. Again some services have clearly only one or only a few users and the allocation is thus quite easy (e.g. airport fees). Some other services will have a variety of users and only proportional allocation might be applicable (e. g certain business services). Checks on the plausibility of the resulting import matrix are also important here.

Even if the calculation of the import matrix needs to be based on certain assumptions, it is important that some emphasis is placed on the calculation of these data. The use table of imports is an important part of the system and for many kinds of input-output analysis separate import matrices are necessary. Furthermore, the step calculation of the use table of imports may also give some indication of necessary changes in the use data at purchasers' or at basic prices.

7.3.2 Specific issues

The preceding subchapter aimed to describe the general procedure in elaborating the use table of imports. In this subchapter, some specific issues with respect to the allocation of the imports are discussed. These issues concern goods processed abroad and investment goods repaired abroad if a substantial amount of reconstruction work or manufacturing is involved. Other problems are generated by re-exports and direct purchases abroad by residents in connection with tourism expenditures. The treatment of imported transport margins was covered in the chapter on valuation.

The first specific issue refers to products that have been exported for processing and the processed products are imported back into the economy. Both the export of materials or semi-processed goods and the import of finished products are part of the import and export flows according to the ESA 1995 definitions. The goods sent abroad become inputs into the foreign manufacturer's production process and the outputs from these processes will be received back, paying the manufacturer a fee for the production carried out. In such cases, the goods sent abroad lose their identity by being transformed or incorporated into other goods. Similarly, the goods received back are essentially new goods produced abroad. Thus, the goods received back may well be classified differently from those which were sent.

The system requires the import and export flows to be recorded on a gross basis, the difference between the value of the imports and the value of the exports should be equal to the payment made for the service provided by the foreign processor. However, the preferred gross treatment of the system leads to some problems in the recording of such transactions in a supply and use framework as the goods shipped abroad for processing would be recorded twice: once as intermediate consumption of the industry which orders the processing and once again under exports. Contrary to the recommendation of the ESA 1995, a net treatment would be more adequate in a supply and use framework. This would mean that the goods sent abroad are separated and deducted from the export flows just as the processed goods delivered from the foreign processor are separated from the import flows, and it is necessary to identify and record separately the import of a manufacturing service which should principally equal the value difference between the processed good received and the goods sent abroad for processing.

A second issue refers to investment goods which are sent abroad for major repair. Again both the export and the re-import are part of the import and export flows. However, in case of minor repair, maintenance, or servicing, the flows concerned are not to be recorded under imports and exports. In case of major repairs, similar problems of recording in a supply and use framework do occur. Thus, for practical reasons one could assume that it usually would be only a minor repair. Furthermore, one could assume that cross-border transportation of investment goods for repair is quite exceptional and thus be negligible (with probably the exemption of aircraft and ships).

A third issue concerns re-exports. Re-exports are transactions of goods which were imported and then exported without any transformation. Such cases do in practice also occur with products that are not produced domestically (e.g. tropical fruits, automobiles). These re-exports are included as exports in foreign trade statistics without any marker. In cases of products that are not produced domestically, any exports of these products could easily be identified as re-exports. However, in the other cases there is no information on re-exports and thus estimates have to be made with respect of the volume and structure of re-exported goods. Some indications on re-exports might be achieved in the balancing procedure of supply and use. It should be noted that – with the exception of transport margins – re-exports of services are, by concept, not possible, thus the identification of re-exports is only a problem for goods.

A specific issue which may also be of some importance concerning the data involved is the direct purchases abroad by residents in connection with tourism. These direct purchases abroad by residents should cover all purchases of goods and services made by residents while travelling abroad for business or pleasure. Such purchases are part of the import flows and need to be estimated on a product basis. Therefore, these purchases have to be allocated to intermediate use in case of business travellers and to household final consumption in the case of private travellers.

However, there is one complication for the above mentioned allocation procedure, namely the case of packaged tours bought from a resident tour operator. The expenditures on the bundle of products that form the package have to be allocated to the intermediate use of the tour operator and thus also when the bundle or part of the bundle has been bought from non-resident providers. This is the consequence of the gross treatment of the output of tour operators in the system. It is thus not always easy to correctly allocate the purchases abroad between the intermediate use of tour operators, other intermediate use in case of business travellers and final household consumption expenditure.

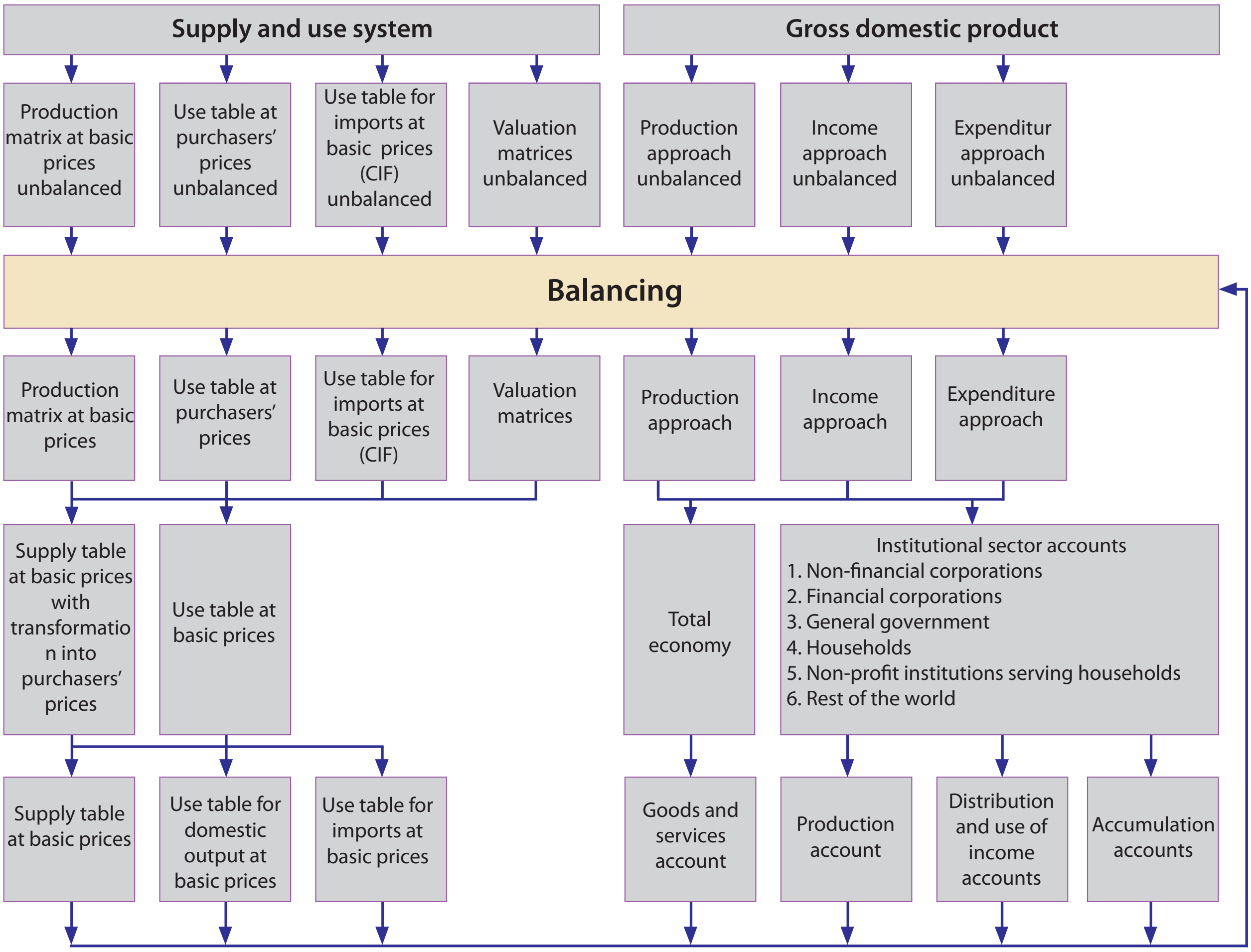
Balancing supply and use

chapter 8

8.1 Introduction

This chapter deals with the balancing of the supply and use system in practice and the balancing of national accounts in general. It contains the framework for balancing supply and uses by industry and categories of final use and by product. It is assumed that at this stage the relevant data on the current year's supply and uses have been prepared in a way that conforms to the concepts used in national accounts. This situation is presented in Figure 8.1.

Figure 8.1: Balancing supply and use



The balancing starts with compiling preliminary estimates of all required inputs to assemble supply and use table at purchasers' prices and at basic prices. The required information contains:

1. Production matrix at basic prices
2. Use table at purchasers' prices
3. Use table of imports at basic prices
4. Valuation matrices

Ideally this information is given for rectangular matrices with many more products than industries.

The production matrix can be obtained by adding the following six production matrices: market transactions of enterprises, market transactions of the General Government, market transaction of NPISHs, non-market transaction of NPISHs, non-market transactions of the General Government and own-final use of enterprises and households.

At the start of balancing an estimate is available for every entry of the supply table, the use table and the valuation matrices. All unbalanced matrices can be compiled from statistical sources supplemented by assumptions based on figures of the previous year. However, in most cases the use table for imports is usually based on a model that will be applied to the data after balancing the supply and use tables. In spite of all efforts it has to be expected that inconsistencies in the estimates remain. The differences can be caused by inaccuracies and inappropriate margins in the preceding estimates, errors in the specification items, non-observed changes of inventories and simply calculation errors. How can inconsistencies be detected and how can they be solved?

For balancing no general theory or useful mathematical programs are available. However, in balancing it is very important to follow a systematic approach to solve the problems. Fortunately, a number of useful instruments are available in a supply and use system to tackle the problems. Basic identities, checks on plausibility and credibility, automatic procedures and error-search procedures help to solve the problems.

A basic requirement for consistency is that basic identities for current and constant price values must be fulfilled. This is decisive for balancing in practice. Every difference between total supply (including margins and taxes) and total use (at current and constant prices) for any product points to an inconsistency. This observation is the starting point for going back to the data and analysing the problem in detail.

In the search for causes of the inconsistencies it can be helpful to carry out a number of credibility checks. In fact, this evaluation is a search for unexpected ratios among data. If something appears to be implausible, one has to look for an acceptable explanation by analysing the underlying sources and discussing the data with experts in the concerned area.

Some examples of plausibility checks are:

- Products
  Comparing price indices of supply and the main use categories
  Comparing shares of the use categories with total supply for subsequent years

- Industry
  Comparing price index of output and price indices of consumed basic materials
  Credibility of resulting price index of total value added and wages and salaries
  Comparing volume indices of output, intermediate consumption and value added
  Index of productivity of labour
  Share of labour income in total valued for subsequent years

It is very time consuming to investigate all the possible problems and inconsistencies in the use of basic statistical data. As the resources for national accounts are limited, a systematic approach is required for balancing. In this process of balancing, it is evident that large inconsistencies require more attention than smaller ones. Inconsistencies may be caused by errors and inconsistencies in the data provided by statistical units (enterprises, establishments, households etc.) and by errors and inconsistencies which were created by the employees of the statistical office.

Examples of balancing problems caused by errors in the sources are: insufficient coordination between data collected by the Central Bank and data collected by statistical offices, and differences in definitions and classifications. Globalisation of production and sales by multinational enterprises is a further important cause of inconsistencies in the data. Examples of balancing problems caused by statistical offices are incorrect product classifications, incorrect grossing up of samples, and errors in transferring data or incorrect estimates for hidden transactions (the black and grey market).

An efficient way to organise balancing a supply and use system is a step-by-step procedure. First: select the large inconsistencies. Second: carry out a critical search for results of data processed at the national accounts department. Especially in the use table, main items are the result of partitioning source data into product groups. The allocation may be changed without altering the original aggregates. In practice one will see that not all problems can be solved in this way. The third step is to consult the expert knowledge of the statistician who is compiling the source statistics. If large inconsistencies still remain, a fourth step is to contact the reporting company for a critical discussion of the data they have provided.

Automation is essential for the preparation and management of the supply and use system. The computer plays different roles in the compilation process. A lot of calculations in the preparation stage are carried out by automatic procedures. In every stage of the process the computer provides quick and clear overviews of the data in every chosen configuration. The computer produces first parts of the supply and use system which are essential for the detection of major integration problems. The computer finally allows searches in the deepest details to efficiently find the causes of balancing problems. Finally, the computer can help to develop appropriate solutions. And last but not least, the computer allows professional documenting of all adjustments made during the compilation process. The computer is a powerful instrument which is indispensable for all operations all the way from the source data to the final set of balanced supply and use tables.

However, computers are not infallible. Statistical offices have tried to develop an integration system that would automatically perform most of the balancing work. Eventually, this approach was abandoned because the results were rather unpredictable. Based on this experience, it seems to be advisable to split up the supply and use system into smaller parts covering a limited number of rows of the supply and use tables. Ideally sector experts will be responsible for the smaller packages of the supply and use system. An integration system must be as simple in its operation as possible. In this case, the integration system relies on the manual integration of small parts of the supply and use tables. While it is advisable to distribute the responsibility for different areas between several people, it is also advisable that all people working on balancing have access to the common database and the files containing the complete supply and use system. In addition, automatic procedures can help to eliminate the small discrepancies between supply and demand. This is often done with the help of proportional corrections. Experience shows that the combination of manual and automatic statistical techniques and procedures is the best workable solution to establish a supply and use system.

8.2 Supply and use tables and the link with the institutional sector accounts

The supply and use system is not a stand alone system in the compilation of macroeconomic data. It is a balancing framework in the core of the national accounts. Generally supply and use tables are accompanied by the institutional sector accounts (see Figure 8.1) and by labour accounts. Another extension of the compilation system are satellite accounts (regional, energy, tourism, health) which are linked to the core system. The integration of these basic statistics provides a complete and detailed picture of the economy.

An important feature of the core system is the link between supply and use tables, the institutional sector accounts, and the satellite accounts. These links allow feedback loops during the compilation and balancing process of the national accounts. Inconsistencies must lead to adjustments in at least one of the frameworks involved. More observed data are used and confronted in the balancing process than in a stand alone approach which is only based on institutional sector accounts. Causes for inconsistencies can be analysed in greater depths and balancing adjustments will be better founded. This integration will result in an increase in reliability and quality of macroeconomic estimates in the national accounts.

Together with the supply and use tables, the institutional sector accounts are in the core of the national accounts. The sector accounts provide an overview of the various economic activities covering production, consumption, generation of income and distribution of income, accumulation of wealth and relations with the rest of the world.

While for supply and use tables the establishment (Kind of Activity Unit) is the unit for which the basic data should be collected, the unit of observation for the institutional sector accounts is the enterprise. The reason is that a large number of transactions are restricted to that level. Examples are transactions in bonds and shares, loans and dividend payments. In the case of small companies, the enterprise and the establishment are the same. Large enterprises consist generally of more than one producing unit.

Institutional sectors are classified, according to their principal activity in the economy:

- Non-financial corporation
  Principally engaged in production of market goods and non-financial services

- Financial corporations
  Principally engaged in financial intermediation and auxiliary financial activities

- General government
  Principally engaged in production of non-market goods and services and in redistribution of income and wealth

- Households
  Consists of all physical persons in the economy. Principal economic functions are labour supply, final consumption, and production of selected market goods and services.

- Non-profit institutions serving households
  Principally engaged in production of non-market services for households. Main resources are voluntary contributions from households.

- Rest of the world
  Not a real sector. The rest of the world account presents all transactions between residents and non-residents.

Like the supply and use system, the institutional sector accounts constitute a balancing framework consisting of a set of well-defined variables and a number of basic identities. For the total economy, the production account and the generation of income account are in fact an aggregate of the domestic production part of the supply and use tables without the dimensions products and industries. One-to-one links exist for production, intermediate consumption and value added. In addition, compensation of employees is directly linked to the supply and use system. Other macroeconomic variables with a strong link between supply and use tables and institutional sector accounts are consumption of households and government (use of disposable income account), and fixed capital formation (capital account). Finally, taxes and subsidies on products and other taxes on production appear in both systems.

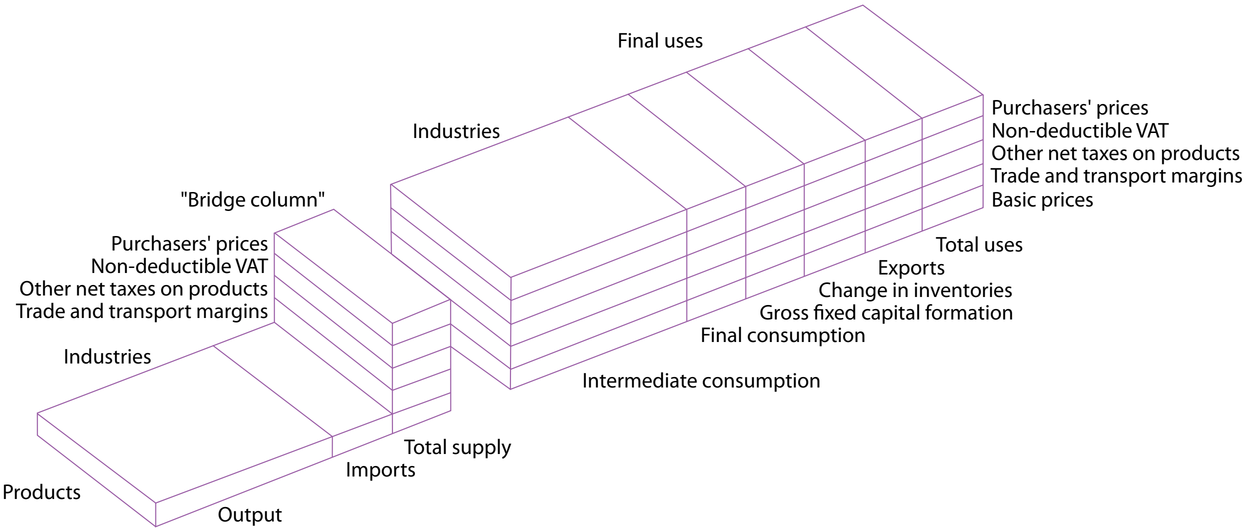
From a conceptual point of view, the links between supply and use tables and institutional sector accounts are strong. However, in statistical practice it is not always easy to transform industry data on production into institutional sector data and vice versa. For that purpose, a set of tables is constructed with a dual classification. In this table the transactions are classified by industry (supply and use tables) and by institutional sector (sector accounts). The corresponding table was presented in Chapter 3 (Table 3.2).

The supply and use tables are the most elaborated and detailed framework to estimate GDP and other macroeconomic variables in the scope of production, consumption, gross capital formation, exports, import, and income. The three methods for estimating GDP are combined in one system based on a great variety of source data which are confronted and compared with each other in order to find possible causes of inconsistencies. Because of the reliability, the strengths, and the quality of supply and use estimates, they have a strong influence on the sector accounts. Largely one can say that there is a one-way traffic between supply and use tables and institutional sector accounts. However, via the dual classification, there are possibilities for feedback in both directions. For the time being, feedback is limited because the level of aggregation in the sector accounts is very high. Therefore, it is difficult to trace back inconsistencies and implausible results on a sector level to specific industries in the supply and use system.

8.3 Balancing the supply and use system

A complete system of product-balances can be illustrated by the three-dimensional figure in Figure 8.2.

Figure 8.2: System of product balances



The submatrices for basic values, trade and transport margins, net taxes on products, non-deductible VAT, and purchasers' values are stacked as "layers" to visualise the transformation from basic to purchasers' prices for each cell of the system.

Products are shown as rows, categories of use (by industries, consumption groups etc. when relevant) are shown as columns. Notice that what is here referred to as rows and columns consist of the relevant parts of all the "layers" shown in the figure.

As a starting point, supply is shown as a matrix of basic values in the left side of the figure. In the balanced commodity flow system, total supply at basic prices must equal total use at basic prices for each product. Trade and transport margins are a special case. On the supply side they are shown as output of trade services at basic prices from the industries in which they are produced but they are left out from the basic price level on the uses side. Here they are shown in the margin matrix where they are distributed together with the basic values to which they are related. Taxes and subsidies on products and non-deductible value added tax are also distributed as matrices for the use side.

Table 8.1: Balancing supply and use of products in practice

No	CATEGORIES / PRODUCTS (CPA)	SUPPLY									
		Output at basic prices	Intra EU imports CIF	Extra EU imports CIF	Wholesale trade margins	Retail trade margins	Transport margins	Other taxes on products	Subsdies on products	Non-deductible VAT	Supply at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10
1	Products of agriculture	6 467	1 039	874	893	731	279	36	- 522	224	10 021
2	Products of industry	115 925	48 544	24 269	19 028	15 213	1 940	6 159	- 405	10 234	240 906
3	Construction work	29 161	217	143				10	- 22	1 716	31 225
4	Trade, hotel, transport services	84 164	2 044	1 512	- 19 921	- 15 944	- 2 219	191	- 1 297	2 805	51 334
5	Financial, real estate, business	70 961	3 580	1 493				1 412	- 36	1 344	78 754
6	Other services	56 112	559	281				590	- 256	517	57 802
7	Total	362 790	55 983	28 571				8 397	- 2 538	16 840	470 043

No	CATEGORIES / PRODUCTS (CPA)	USE									
		Intermediate consumption	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total use at purchasers' prices
No		11	12	13	14	15	16	17	18	19	20
1	Products of agriculture	6 426	2 561		176	108		242	397	112	10 021
2	Products of industry	91 384	55 434		2 111	22 231	163	792	42 232	26 561	240 906
3	Construction work	8 724	1 032			20 761			429	280	31 225
4	Trade, hotel, transport services	18 847	26 586		328	67			3 285	2 223	51 334
5	Financial, real estate, business	46 221	22 156		195	4 254		- 24	3 606	2 345	78 754
6	Other services	7 049	9 507	3 670	36 988	251	61		187	90	57 802
7	Total	178 652	117 274	3 670	39 797	47 672	224	1 009	50 135	31 611	470 043

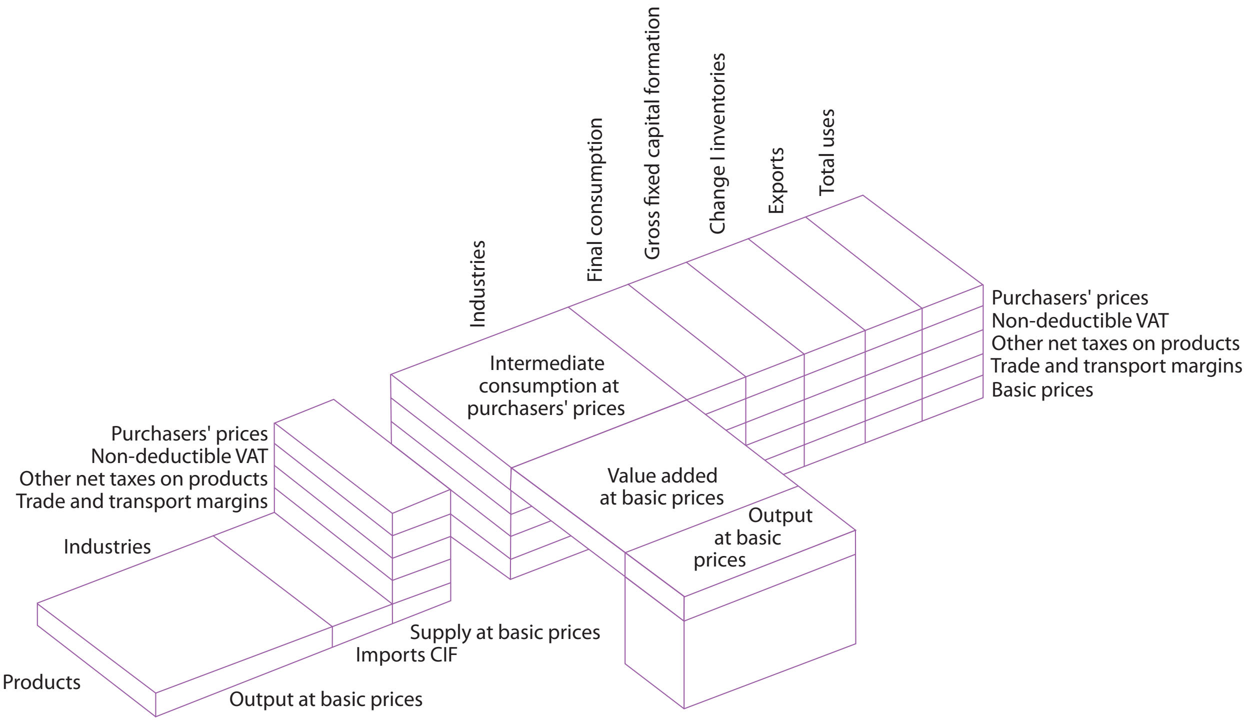
Austria 2000

The gap between total supply and use at for each product is closed by a "bridge column" that is shown at the right side of the supply. Here margins are moved from the basic value layer to the margin layer. In the basic values layer the margins are shown as negative values that cancel out the supply of the "margin- products". By the margins layer the same total amount is distributed as supply of margins on all traded products. The "bridge column" is also used to show the "supply" of net taxes on products and non-deductible VAT by product. It follows that in the balanced system total use will equal total supply at all levels for each product when the supply side includes the "bridge column".

Table 8.1 shows the balancing of supply and use of products in practice. For each product, an empirical example demonstrates how the balance of supply at purchasers' prices is attained with the corresponding use at purchasers' prices. At first the output of a product is calculated at basic prices. Then imports (CIF) are added to define total supply of a product at basic prices. In a third step, trade and transport margins are added to total supply at basic prices. Note that trade and transport margins, in contrast to net taxes, reflect only a different allocation of trade and transport margins at purchasers' prices. While at basic prices the trade margins are deducted from trade, hotel and transport services, they are added to the traded products to reach purchasers' prices. In other words, at purchasers' prices each product contains not only the basic production costs but also the trade and transport margins and the net taxes on products. The net taxes on products contain other taxes on products, subsidies on products and the non-deductible value added tax (VAT).

A simplified version of the supply and use system is illustrated in Figure 8.3. Here the uses side is only presented at purchasers' values as the top layer. The figure corresponds to Table 15 and Table 16 in the ESA 1995 transmission programme of data and Table 9.5 and Table 9.6 in ESA 1995. VAT and all other taxes and subsidies on products are treated as a single aggregate layer. The value added section of the use table has been added to illustrate that the figure corresponds to the use table of the official transmission programme for ESA 1995. Value added at basic values by industry is the difference between output in basic prices and intermediate consumption at purchasers' prices by industry. In the balancing procedure one can assume that the targets for output, intermediate consumption, and value added by industry have already been fixed. The three-dimensional structure is used to show that supply and use tables are a subset of the information contained in the full system.

Figure 8.3: Simplified supply and use system



The system for balancing supply and uses by products is illustrated by the two figures:

- In the full system with all levels available on the uses side the balancing of basic prices, trade- and transport margins, net taxes on products and VAT can be carried out simultaneously as described in the rest of this chapter.
- A simplified version of the balancing-exercise can be limited to the values shown in the small version of the system. In this case balancing will mainly affect the use side at purchasers' values. The missing matrices for trade- and transport margins, net taxes on products and VAT that were shown on the uses side in the complete system may be calculated in a following step after supply and uses at purchasers' prices have been balanced.

The choice between simultaneous balancing of all levels and balancing at purchasers prices alone will of course depend on availability of data and human resources.

Despite the apparent simplicity of a simplified system it may actually create complications that could be avoided by simultaneous balancing of all levels. Supply at purchasers prices must be calculated before balancing can be carried out at purchasers' prises. Trade and transport margins, net taxes and VAT by product might, for instance, be calculated using information from previous years or other information that does not depend on the balancing procedure itself, disregarding the fact that this will probably create an internal incoherence in the system. Such inconsistencies will probably reveal themselves if the missing layers on the uses side from basic values all the way to VAT are compiled at a later stage. With simultaneous balancing of all levels on the uses side the distribution of margins, taxes and VAT by products need not to be fixed in this early stage. They can be allowed to reflect the changes that are introduced on the uses side during the balancing procedure.

The distribution by products of trade- and transport margins and net taxes on products may be calculated outside the balancing process itself based on detailed information on the trade industries, household budget surveys, etc. If taxes and subsidies are not already related to the relevant products in statistical sources, it should at least be possible to construct the distribution by products from information in government accounts. These calculations can be carried out before the start of the balancing process itself.

On the other hand, it is difficult to calculate non-deductible value added tax by product without using the detailed information on the uses side, as the magnitude of non-deductible VAT will usually depend on both the product and its distribution among the different uses. This is the reason why the VAT and purchasers value-layers of the bridge-column will not be available until the final balancing of the whole system.

ESA 1995 recommends that a complete system of trade and transport margin matrices and matrices for VAT and other taxes and subsidies on products is established. Balancing supply and uses at all levels simultaneously should be preferred for a number of reasons. One reason is that trade and transport margins and non-deductible VAT should reflect the uses of the current year and not those of a previous year. Another reason is that the breakdown of all purchasers' values into basic value, trade and transport margins, net taxes other than VAT and VAT is needed for deflation purposes and must be calculated later if it is not present when the balancing is carried out. A very good reason is that in the balancing process modern computer systems can easily do most of the work involved in maintaining an updated version of all the layers of the system.

If a system with 1000 or more product balances is going to be balanced every year, the system will for obvious reasons depend on electronic data processing in one form or another. The system of product balances can, in principle, be viewed as a flat master file. For every new year an initial file must be created using data from numerous statistical and other available sources. Once a complete system has been created for a base year, compiling initial files for following years can be viewed as an updating procedure, where an existing file is adjusted to the new targets for totals and to independently calculated values of the current year. Corrections to the initial version of the product balances can be viewed as one or more transaction files that must be merged with the master file to create corrected versions of the original file. However, the actual implementation may use different types of software such as databases and spread sheets.

Balancing a detailed commodity-flow system by manual corrections alone could be time and resource consuming even with the help of modern electronic data processing. To be manageable, the system would probably need to be limited in size with no more than a few hundred products. On the other hand, a commodity-flow system that is merely an automatic projection of a base year with a new set of target totals could easily move away from statistical sources, and one might miss the obvious opportunity to check the internal consistency of the system and to detect and correct possible errors in the underlying data from primary statistics. A combination of automatic procedures and manual adjustments is needed to create a detailed, consistent system of product balances.

The process of compiling a balanced commodity-flow system can be summarised in the following way:

The first step will be to gather all information on target totals and the values that can be entered directly into the system as predetermined. It is here assumed that these have already been prepared and that all data from subsystems that produce input to the balancing process have already been compiled.

The next step will create an initial version of the product balances. This version can be compiled using automatic processes, but at this stage a number of unsolved problems will remain: For some products supply will not equal uses. For most categories of use the totals will usually differ from their targets. Total trade and transport margins and total VAT may also differ from their respective targets. This step will be referred to as "Automatic balancing".

Then follows a step in which the initial version of the product balances is adjusted manually. The unsolved problems are examined closely. In many cases such problems will reveal errors in the calculations that produce data input to the product balances or in the primary statistics itself. Solutions to such problems may be found in co-operation with the relevant sections of the statistical office and may involve changes in supply, predetermined uses, or target totals. A number of products are redistributed between uses to bring the distance between totals and targets within an acceptable range for each category of use. Corrections to the initial balances are entered into the system to create a new - but not yet final - version. This step will be referred to as “Manual balancing”.

In the last step the differences between totals and targets are removed except where such differences are considered acceptable. In this step trade and transport margins and VAT are finally adjusted to their targets. This step will be referred to as “Final balancing”.

The results of the final balancing are demonstrated for an empirical example. In Table 8.2 the supply table comprises the supply of products at basic prices including the “bridge column” with the transformation into purchasers’ prices.

Table 8.2: Supply table

	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)							IMPORTS				VALUATION		
		Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total domestic output at basic prices	Intra EU imports CIF	Extra EU imports CIF	Imports CIF	Total supply at basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply at purchasers’ prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Products of agriculture	6 467						6 467	1 039	874	1 912	8 380	1 903	-262	10 021
2	Products of industry	889	111 350	626	2 749	62	248	115 925	48 544	24 269	72 812	188 737	36 181	15 988	240 906
3	Construction work	140	1 132	27 356	429	36	67	29 161	217	143	360	29 521		1 704	31 225
4	Trade, hotel, transport services	150	3 375	399	79 355	447	439	84 164	2 044	1 512	3 557	87 721	-38 085	1 696	51 332
5	Financial, real estate, business	13	1 428	211	1 953	66 939	416	70 961	3 580	1 493	5 073	76 033		2 722	78 756
6	Other services	4	58	5	200	2	55 843	56 112	559	281	840	56 952		850	57 802
7	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790	55 983	28 571	84 554	447 344	0	22 699	470 043
8	CIF/ FOB adjustments on imports								-133	-30	-163	-163			-163
9	Direct purchases abroad by residents								4 997	3 160	8 157	8 157			8 157
10	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790	60 847	31 701	92 548	455 338	0	22 699	478 037

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Table 8.3 shows the corresponding use table with a transformation of the use table at purchasers’ prices into a use table at basic prices. It should be noted that the matrices of use-side trade and transport margins and taxes less subsidies on products have the same format as the use table. In the use table at purchasers’ prices, all intermediate and final uses of products are given at purchasers’ prices. If the corresponding trade and transport margins and taxes less subsidies on products are deducted, intermediate and final uses of products at basic prices result. In the use table at basic prices, taxes less subsidies have to be added in a separate row of the use table. Row 8 of the use table at basic prices corresponds to Row 7 of the tax matrix.

It should be noted that the following identities hold after balancing:

- Total supply at purchasers’ prices in column 14 of Table 8.2 equals total uses at purchasers’ prices in column 17 of the use table at purchasers’ prices in Table 8.3.
- Total supply at basic prices in column 11 of Table 8.2 equals total uses at basic prices in column 17 of the use table at basic prices in Table 8.3.

An empirical example with more detailed information is available for 59 products and 59 industries with separate valuation matrices for wholesale trade margins, retail trade margins, other taxes on products, subsidies on products, and non-deductible VAT.

Table 8.3: Use table

No	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES (NACE): Agriculture	Industry	Construction	Trade, hotel, transport	Finance, real estate, business	Other service activities	Total	FINAL USES: Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exportsextra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Use table at purchasers' prices																	
1	Products of agriculture	1 705	4 104	30	482	11	95	6 426	2 561		176	108		242	397	112	3 595	10 021
2	Products of industry	1 678	55 020	9 212	14 043	3 701	7 730	91 384	55 434		2 111	22 231	163	792	42 232	26 561	149 522	240 906
3	Construction work	99	542	1 993	950	3 695	1 445	8 724	1 032			20 761			429	280	22 501	31 225
4	Trade, hotel, transport services	83	4 420	401	11 129	1 321	1 493	18 847	26 586		328	67			3 285	2 223	32 488	51 334
5	Financial, real estate, business	171	7 400	1 732	10 490	21 810	4 618	46 221	22 156		195	4 254		- 24	3 606	2 345	32 533	78 754
6	Other services	102	1 323	77	813	1 682	3 052	7 049	9 507	3 670	36 988	251	61		187	90	50 753	57 802
7	Total	3 837	72 808	13 445	37 907	32 221	18 433	178 652	117 274	3 670	39 797	47 672	224	1 009	50 135	31 611	291 392	470 043
8	Cif/ fob adjustments on exports														- 133	- 30	- 163	- 163
9	Direct purchases abroad by residents								8 157								8 157	8 157
10	Domestic purchases by non-residents								- 12 360						9 528	2 832		
11	Total	3 837	72 808	13 445	37 907	32 221	18 433	178 652	113 071	3 670	39 797	47 672	224	1 009	59 530	34 413	299 386	478 037
12	Compensation of employees	504	25 517	8 298	26 129	14 458	32 269	107 174										
13	Other net taxes on production	- 906	908	345	981	883	810	3 021										
14	Consumption of fixed capital	1 520	6 407	1 007	6 634	9 363	4 642	29 574										
15	Operating surplus, net	2 709	11 705	5 501	13 036	10 561	859	44 370										
16	Value added at basic prices	3 826	44 536	15 152	46 779	35 265	38 580	184 138										
17	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790										
	Trade and transport margins																	
1	Products of agriculture	165	587	4	133	2	13	904	928			3		3	51	15	999	1 903
2	Products of industry	313	4 782	1 421	2 039	450	956	9 961	17 250		917	4 694	1	105	1 953	1 300	26 220	36 181
3	Construction work																	
4	Trade, hotel, transport services	- 478	- 5 369	- 1 425	- 2 172	- 451	- 970	- 10 866	- 18 177		- 917	- 4 697	- 1	- 108	- 2 004	- 1 315	- 27 219	- 38 085
5	Financial, real estate, business																	
6	Other services																	
7	Total																	
	Taxes less subsidies on products																	
1	Products of agriculture	- 5	- 245		- 42		- 3	- 295	79			1		- 1	- 35	- 11	34	- 262
2	Products of industry	107	552	168	803	247	1 042	2 917	11 728		346	1 055	9	1	- 53	- 15	13 071	15 988
3	Construction work			- 1		97	137	233	164			1 308					1 471	1 704
4	Trade, hotel, transport services	- 2	- 189	- 10	- 139	18	62	- 259	2 177		- 50	5			- 126	- 51	1 955	1 696
5	Financial, real estate, business	6	73	11	113	312	277	791	1 235			702			- 4	- 2	1 931	2 722
6	Other services		12	2	12	62	38	127	916		- 198		6				724	850
7	Total	106	202	169	747	737	1 552	3 514	16 299		98	3 071	15		- 218	- 79	19 186	22 699

Use table at basic prices

1	Products of agriculture	1 544	3 762	26	392	9	84	5 817	1 554		176	103		240	381	108	2 562	8 380
2	Products of industry	1 258	49 687	7 623	11 201	3 005	5 732	78 506	26 456		848	16 483	153	685	40 331	25 276	110 231	188 737
3	Construction work	99	542	1 993	951	3 598	1 308	8 492	868			19 453			429	280	21 030	29 521
4	Trade, hotel, transport services	563	9 978	1 837	13 439	1 754	2 400	29 971	42 586		1 295	4 758	1	108	5 415	3 589	57 752	87 723
5	Financial, real estate, business	165	7 327	1 721	10 377	21 498	4 342	45 430	20 921		195	3 553		- 24	3 610	2 347	30 601	76 032
6	Other services	102	1 310	76	801	1 620	3 014	6 922	8 591	3 670	37 185	251	55		187	90	50 030	56 952
7	Total	3 731	72 606	13 276	37 161	31 484	16 880	175 138	100 975	3 670	39 699	44 600	209	1 009	50 353	31 690	272 206	447 344
8	Taxes les subsdies on products	106	202	169	747	737	1 552	3 514	16 299		98	3 071	15		- 218	- 79	19 186	
9	CIF/ FOB adjustments on exports														- 133	- 30	- 163	- 163
10	Direct purchases abroad by residents								8 157								8 157	8 157
11	Domestic purchases by non-residents								- 12 360						9 528	2 832		
12	Total	3 837	72 808	13 445	37 907	32 221	18 433	178 652	113 071	3 670	39 797	47 672	224	1 009	59 530	34 413	299 386	478 037
13	Compensation of employees	504	25 517	8 298	26 129	14 458	32 269	107 174										
14	Other net taxes on production	- 906	908	345	981	883	810	3 021										
15	Consumption of fixed capital	1 520	6 407	1 007	6 634	9 363	4 642	29 574										
16	Operating surplus, net	2 709	11 705	5 501	13 036	10 561	859	44 370										
17	Value added at basic prices	3 826	44 536	15 152	46 779	35 265	38 580	184 138										
18	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790										

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The supply and use tables at basic prices are the foundation for the transformation of supply and use tables to input-output tables. This transformation is discussed in Chapter 11 (Transformation of supply and use tables to symmetric input-output tables).

8.4 Assumptions about available data for the current year

Before the supply and use system can be compiled, the necessary data must be available. It is assumed, that the following data have been prepared in a suitable form. The description of how they are compiled from statistical and other sources is covered by chapters 4 and 5 of the manual.

Supply side at basic values

- Output at basic prices by industry and by product
- Imports CIF by product

Use side at purchasers' prices: targets for column totals

- Intermediate consumption by industry
- Private, individual and collective consumption by purpose
- Gross fixed capital formation by category
- Changes in inventories
- Exports FOB by product
- Total trade and transport margins may be specified for some uses

Use side at purchasers' prices: targets for row totals

- Total use = total supply by product at basic prices
  The targets are here implicitly given by the row-totals of the supply-matrix at basic prices.

- Trade and transport margins by commodity
  Such targets for row totals may be calculated in a subsystem.
- Taxes and subsidies on products by product

Use side: targets for total use

- Trade and transport margins
- Total value added tax

Use side: predetermined values

- Exports by product at purchasers' prices
- Changes in inventories by product (should be calculated in a subsystem.)
- Subsystems covering special areas of the uses side at basic prices and at purchasers' prices
- Fully predetermined products and fully predetermined categories of use
- Other information on areas or specific cells on the uses side

It is assumed that targets are available for all column totals at the uses side and that the difference between total supply and the total use indicated by the targets is reflected within an acceptable limit.

The target values can be expected to be of different quality depending on the available statistical sources. At any stage of the compilation, the balancing procedure may reveal the need for revisions of some target values. As a result one may decide to adjust some of the target values that were originally used in the automatic balancing process. The targets that are set for manual balancing may also change before final balancing is carried out.

8.5 Initial version of supply and uses with predetermined and estimated values

8.5.1 A complete but unbalanced system

Before any balancing can be done, the system of product balances must exist in a more or less unbalanced form. When the commodity-flow system is created from scratch the whole system must be filled with values for at least one base year. In areas where no statistical information is available one must search for other types of information like enterprise accounts and other published material. It is often possible to find people who have some knowledge on the conditions in industries that are poorly covered by statistics. Even when this kind of knowledge may be difficult to quantify it can be useful in the absence of verified statistical information. Combined with common sense it may not be the worst solution. At least the more improbable values can be avoided in this way. A last resort could be to look at material from neighbouring countries.

In an established commodity-flow system, the problem of missing information is smaller. A default solution is here to use values and relations from the balanced commodity-flow system of the preceding years. In the absence of better knowledge, one can assume that input structures are constant, and that trade margin percentages, percentages of taxes on products, and VAT are constant over time or at least move in the same direction in a proportional way.

The data used to create the initial estimates will, of course, be more or less suitable for the purpose. The quality of the data will vary from solid statistics through common sense estimates to pure guesswork. Initial values of high quality should as far as possible be kept constant during the balancing procedure and the changes that are needed to balance the system should preferably affect the more uncertain values.

8.5.2 Predetermined values

The term "predetermined values" is here used for values that are entered directly into the system and kept constant at their original values during the process of automatic balancing. There can be several reasons to keep values constant during automatic balancing. They may be considered to have a high degree of certainty, or they may just be considered better estimates than the values that can be expected to emerge from an automatic balancing process. It does not necessarily follow that all cells that are treated as predetermined in the compilation of an initial version of the commodity flow should not be corrected manually later in the process.

The available information may in some cases show the exact values to be entered into specific cells of the system. Examples are accounts data with full coverage and a high level of detail or detailed data that have already been grossed up when they were received from the providers of primary statistics.

When comprehensive information is available about a group of related products, it may be feasible to compile the supply and use balances for these products in a separate subsystem. In principle, no further balancing of these commodities is needed, and they can be treated as predetermined rows when the general balancing is carried out.

The same applies to some categories of use. If they can be specified in detail before the start of the general balancing process, it is feasible to treat all values in these columns as predetermined in the general balancing process.

When deciding which values should be considered predetermined and which values should be allowed to change in the balancing process, one should of course take into consideration the quality and coverage of the statistical sources. It is, however, also necessary to look at the way these values fit together in the system. When, for instance, predetermined values add up to a high percentage of the intermediate consumption of an industry, the residual may tend to fluctuate from year to year in a way that seems improbable. Without adjustments, the automatic changes in other inputs will result in big changes in the input coefficients from one year to another in this industry. If this is considered unrealistic, one has the choice either to manually adjust some predetermined values, to change the target total, or to decide that one or more of the inputs that were originally predetermined should be allowed to change in the balancing procedure.

8.5.3 Other values estimated from statistical information for the current year

However many statistical sources based on samples do not contain information on the actual values that need to be entered into the cells of the system, but they are used to break down the current year's totals into these values. Even if the statistical data behind such breakdowns refer to the current year, values calculated in this way are less likely to be chosen as predetermined because they may to some degree be a result of assumptions that cannot be proved.

8.5.4 Statistical information from preceding or following years

In many areas comprehensive information may be available for specific years only, and the same information will have to be utilised for a period of time following each census year. When, for instance, a survey of the use of raw materials in manufacturing is carried out regularly with an interval of some years, a procedure should exist for revision of the composition of intermediate consumption in manufacturing each time the results from a new survey is available. It may sometimes even be feasible to use results of statistical surveys covering periods after the current year because this must be considered the best way of using recent information. This does not imply that a general revision of the whole system is required when this kind of information is entered into the system.

The initial version of the uses side should as far as possible utilise all available information on the current year and other recent information. Nevertheless, all cells in the system must be assigned as initial values whether or not recent information for each particular cell is available.

8.5.5 Moving from one year to another

When a balanced commodity-flow system already exists for the year previous to the current year, it can usually be assumed that the general structure of the system will be like the preceding year when no better information is available. Occasionally, specific changes from one year to another need to be taken into account. Changing nomenclatures of products may create a need for redefining some product groups, and new industries or consumption groups may be introduced. In these cases it is usually possible to transform the file from the previous year into the structure of the current year.

To take into account changes in the price structure, data from other periods can be inflated (or deflated) to the price level of the current year before they are used to calculate initial input structures of the current year. In this way the initial values are calculated using the assumption, that input coefficients in constant prices are stable over time.

8.5.6 Bringing together information from the different sources

A preliminary system of unbalanced "product balances" is then put together using the best possible data source for each value.

It is assumed that the complete supply side has been calculated for the current year. All values on the supply side should be entered into the file and should be treated as predetermined values in the automatic balancing process. Empty cells that used to have a value in earlier years should be deleted from the file or set to the value of zero. It may, on the other hand, be a good idea to check that the data-input is complete in such cases.

On the use side, all predetermined values should be preferred to default values calculated in other ways.

When complete rows or columns are calculated in subsystems and entered into the master file as predetermined values, the cells in these rows or columns that do not get a predetermined value should be deleted from the file or filled with zeroes.

Exports at purchasers' values are known by product from primary statistics and should be treated as predetermined. Changes in inventories may not be known by product in the strict sense, but when a distribution is calculated in a subsystem, it may nevertheless be a good idea to treat these changes at purchasers' values as predetermined to avoid changes to their column totals during the automatic balancing process.

When the input structure of industries can be based on recent surveys of the use of raw materials or services, this structure should, of course, be preferred to the input structure that could be calculated from the inflated file from the preceding year. In the same way, the structure of private consumption can be based on surveys of consumer expenditure, if not every year then at least at regular intervals.

Some types of gross fixed capital formation may already have been calculated in special subsystems to calculate capital stock data. Investment in construction and civil engineering works may be known from the system that is used to calculate production in the construction industry. It may also be possible to decide on the size of investment in automobiles, railway rolling stock, ships, aircraft, etc., outside the general supply and use framework. In these cases the values can be entered as predetermined.

Compiling good initial columns of gross fixed capital formation in other machinery and equipment, software, artistic and literary originals, or net acquisitions of valuables may prove more difficult. Ideally, a complete product by industry matrix should be created for each of these categories. In principle such matrices could be an integral part of the supply and use system. In practice they may exist as special subsystems. Several reasons can be given for this. Primary statistics are often scarce in these areas, and the "investment structures" of industries can be expected to be less stable over time than the input structures. If the investment matrices have to be finished together with the rest of the supply and use system, it might slow down the balancing procedure. Nevertheless, it might be possible to use a preliminary version of such a subsystem to create initial columns for the categories of gross fixed capital formation that are preferred to the columns from the inflated system from the preceding year.

It can be argued that production, imports and exports that were treated as predetermined values may actually be uncertain and should be allowed to change during the balancing procedure. However, such changes are difficult to manage in the automatic balancing procedure. If necessary these values can be changed later by manual corrections.

8.5.7 Initial trade and transport margins

When a commodity-flow system is created from scratch, trade and transport margins must be assigned to each product that carries such margins. In the figures above, all margins are shown as a single layer, but in practice wholesale, retail and transport margins may be separated into several layers. It should be stressed that "transport margins" cover only the share of total transport services that is not already shown separately as intermediate consumption of transport services in the accounts of the units that sell or buy the transported goods. Total margins by product may be based on accounts statistics for the trade industries using assumptions on the mix of traded products through each branch of trade. Any other type of available relevant information may also be used when an initial set of trade and transport margin percentages is created.

In the full system trade and transport margins for each product must be distributed over the uses of that product. The trade and transport margin percentages may show some variation between different uses of the same product. The obvious case is that retail trade margins are high for private consumption and may be lower for other categories of final use while in most industries intermediate consumption and gross fixed capital formation carry no retail trade margin at all. Wholesale trade margin percentages may also vary between uses: They are more likely to be higher in the cases where many suppliers are confronted with many buyers of the product than in the case where a few big enterprises are buying the product from a few big suppliers. In the absence of hard information on such differences use of common sense may lead to more realistic assumptions than the use of uniform trade margin percentages for all uses of the same product.

When moving a balanced supply and use system from one year to the next year, a first estimate of the initial trade and transport margin matrices as default can be based on the trade margin percentages from the preceding year. Where trade and transport margins in the current year are known, these values should, of course, be preferred to the default values. Such values for specific cells can be entered into the system as predetermined.

The total margins that are calculated in this way will usually not add up to the supply of trade and transport margins, so some proportional adjustments of the non-predetermined margins may be needed before the margin layers can be used in the initial version of the uses side.

8.5.8 Initial other taxes and subsidies on products

It is assumed here that taxes and subsidies on products are known by product before the start of the balancing process. In the full system they will have to be distributed to all the categories of use that pay taxes or receive subsidies. When a system is built from scratch, every type of tax or subsidy must be distributed according to the relevant legislation. For instance, some taxes on products may be paid exclusively by private consumption, others should be distributed among all uses except exports in proportion with basic values, and some subsidies may be received by selected industries only.

When moving from one year to the next, a default solution like the one proposed for trade and transport margins can be used if the tax rules are the same in the two years. In such cases a first estimate of taxes on products can be calculated using tax percentages from the preceding year. The taxes calculated in this way will only add up to the row targets by coincidence, but in a later step the tax on each product can be proportionally adjusted to the target value. This automatic procedure is somewhat more dangerous than the similar procedure for trade and transport margins. It should be used with care, especially where rows contain combinations of taxes and subsidies. To eliminate the risk of improbable results, it is a good idea to enter all taxes and all subsidies in such a row as predetermined values. Often the only safe solution will be to calculate the distribution manually.

8.5.9 Initial value added tax

According to ESA 1995, only non-deductible VAT is entered into the system. In the full system, non-deductible VAT is distributed by product to industries and categories of final uses which are exempted from the deduction of VAT. Unlike trade and transport margins and other net taxes on products, the VAT distribution by products is difficult to calculate without the knowledge of the detailed uses side of the system.

In each product cell of the use table VAT will depend on:

- The VAT rate. The rates may be different for different products.
- The share of the product's value that is exempted from VAT.
- The share of the value that is hidden from taxation.
- The share of VAT that is deductible in each industry when the product is used as intermediate consumption or gross capital formation. This share will be zero in industries that are not allowed to deduct VAT.
- Any exception or special arrangement that follows from the VAT legislation and administrative practices. Examples: VAT on certain products may never be deducted whether they are used by industries that deduct VAT or not; products may be VAT exempt when used for certain purposes. VAT for certain products may be based on basic value plus trade and transport margins while the general rule is that VAT is paid on the sum of basic value, trade and transport margins and other net taxes.

- A downward adjustment may be needed when legislation allows for deduction of bad debts from taxable value added.

VAT legislation can be simulated using an Electronic Data Processing (EDP) procedure. In a detailed system it is possible to calculate VAT for each individual cell of the uses side. The VAT values can also be updated whenever values on the uses side are changed in the balancing process. The total VAT that is calculated initially can be compared with the total VAT as shown in government accounts. This comparison may show a need for adjustments in the procedure used for estimating VAT or in some of the initial values of the system.

As in the case of intermediate consumption, non-deductible VAT on investment will depend on the distribution of gross fixed capital formation among industries. This is an important argument in favour of compiling a set of initial investment matrices before creating the initial version of the uses side.

8.5.10 Use of virtual products and industries

Some products are used in most industries in small amounts as intermediate consumption, but the input structures for these products cannot be based on statistical sources. Examples can be electric bulbs, pencils, stationery, small utensils for office use, etc. In business accounts, expenditure for such products will often be hidden as "other expenditure" together with various services because they are typically not raw materials for industrial use. If the complete distributions of supply and use for each of these products are shown in separate rows, balancing may become unnecessarily time consuming taking into account the lack of information and the relative small amounts used in each industry. On the other hand, it may not be appropriate to collapse the original products into a single product since they will often belong to different parts of the product nomenclature.

However, to facilitate the balancing procedure one may prefer to show the uses of such combinations of products as single rows of "virtual products" while the balancing takes place. Technically the conversion from original products into a combined "virtual product" is done by introduction of a corresponding "virtual industry". On the uses side, a column for input in the virtual industry is added. It receives inputs of the products that are grouped together as the virtual product. In the supply matrix a column for output from the virtual industry is added. The only value in this column is the supply of its corresponding virtual product. When the system is balanced, output of the virtual product at basic prices must equal the total of the intermediate inputs in the corresponding virtual industry at purchasers' prices.

These rows and columns are, of course, only used as technical aids in the balancing process and should be eliminated when the balancing is finished. It follows that no value added is created in a virtual industry and it will, of course, not have any employment or capital formation. In the balancing process, virtual products are distributed among uses like any other commodity. When the system is balanced, the virtual industry and the corresponding virtual product can be replaced by a product by industry matrix using the assumption that each use of the virtual product consists of proportional shares of all the inputs in the virtual industry. It must be emphasised that products grouped together as one virtual product should be of relatively insignificant sizes.

8.6 Balancing procedures

8.6.1 Automatic balancing

Before the start of the automatic balancing procedure all data are put together as a complete unbalanced commodity flow system for the current year. In practice an EDP file is created with values in all cells that are supposed to be non-zero in the finished system.

All predetermined cells are assigned their correct values. Predetermination must be recognisable to the computer application; otherwise predetermined values would change during the balancing process. A simple solution is to put a mark in the record whenever a value is predetermined. When all levels of the uses side are balanced simultaneously, the levels should be marked individually. Predetermined values on the uses side may not always be specified for all levels from basic to purchasers' value. To ensure that all records are consistent, an EDP procedure must recalculate non-predetermined levels of the records containing predetermined values using relations from the default records of those cells.

All other cells are filled with their initial values. Where no other information is available, the inflated values of the preceding year serve as default values.

In the unbalanced file, use will not equal supply at basic values for most products, and the column totals will usually differ from targets.

Vertical balancing (columns adjustments)

A first step towards a balanced system is the adjustment of the column totals to the columns targets. For most uses, targets exist for totals at purchasers' values. In the full system targets may exist for other levels as well. Trade margins used in certain consumption groups can be an example.

The adjustments should not change any predetermined values. When adjusting purchasers' values to the target, the sum of all predetermined purchasers' values must be calculated. It is important to note that in simultaneous balancing at all levels; some values may be implicitly predetermined as a result of other levels being predetermined. Also the share of VAT that can be calculated from predetermined values should be treated as predetermined.

To adjust a column, all non-predetermined purchasers' values are multiplied by:

(Target value - sum of predetermined values) / (original total - sum of predetermined values).

In the simple case with a target for purchasers' values only, the same correction factor can (in principle) be used for non-predetermined values at all levels. If targets exist for other levels, the situation is somewhat more complex and there is a need for general corrections to trade margin percentages and tax percentages used in the column. All these problems can be solved with some clever programming.

Some restrictions should be put on the automatic adjustments to avoid creating improbable values. Automatic changes of sign should not be allowed. It is a good idea to restrict acceptance of negative basic and purchasers' values to certain products that may be negative. Examples are disinvestment (scrap, ships, and cars) and changes in inventories. When both positive and negative uses are present in the same column the results of proportional adjustments can be unpredictable. In such cases, one may prefer to enter all negative uses as predetermined values. Negative trade and transport margins outside changes in inventories should – as a general rule – only be accepted as predetermined values. The programming can ensure that such improbable values are trapped and replaced by acceptable values. Warnings should be issued when problems of this kind are encountered.

It follows that automatic adjustment will, in certain cases, fail to equal column totals to targets. In these cases the columns can be referred to a list of unsolved problems. If predetermined values are marked in the list, the cause of the problem will often be obvious.

After "vertical balancing", we have a set of columns that (with the exception of the problematic columns mentioned above) represent an initial breakdown of the target value for purchasers' values into products using the initial assumptions for input coefficients of industries except for those inputs that have been deliberately changed by pre-determined values.

Total use of each product will only equal supply in special cases as a result of predetermined values or by pure coincidence. This applies to all levels with target values on the supply side. As a consequence, the difference between total calculated trade and transport margins and their target values can be misleading and should not be used to judge the realism of the general level of trade margin percentages. On the other hand total VAT may be rather close to what it will be in the final balancing, if the same assumptions are used in the VAT-calculations.

In principle it should be possible to eliminate all the differences between supply and use by manual corrections. However in a system with 1000 or more products this would be an extremely time consuming task. Therefore, automatic elimination of most of these differences should be preferred.

Horizontal balancing (row adjustments)

When no better knowledge is available, it seems sensible to assume that substitution between products tends to move in the same direction in most uses. The next step towards a balanced system should therefore be an adjustment of the row totals to the row targets. As shown earlier in this chapter, a simplified commodity flow system may only have targets for purchasers' values by products.

In this case, balancing the supply and uses of each row is done by multiplying each of the original non-predetermined values at the uses side by:

(Supply at purchasers' prices - sum of predetermined values) / (original total - sum of predetermined values).

In the full system, such targets will exist for basic values as a result of the assumption that the supply matrix at basic values is complete and predetermined. If there is a need to correct basic values on the supply side, it ought to be done either by entering other values for the predetermined supply or by entering corrections to the row later in the manual balancing process. Targets for trade and transport margins by product may exist for some or all of the rows. Usually target totals also exist for net taxes on products other than VAT.

Here, corrections should start at the basic values level. The sum of predetermined values at basic prices should be calculated including such values that are implicitly predetermined. This will have to include basic values in cells with predetermined purchasers' values to avoid either distortion to trade margin percentages or changes to the original predetermined purchasers' values of these cells.

All the non-predetermined basic values are multiplied by

(Supply at basic prices - sum of predetermined values) / (original total - sum of predetermined values).

In these uses, non-predetermined margins and taxes on products are changed by the same factor. If the row has a target for trade and transport margins a similar proportional correction can be made to all non-predetermined trade and transport margins of the row. If changes to margins are allowed in uses with predetermined purchasers' values, the situation becomes more complex. In this case an iterative solution may be required to solve the problem. Consequently, corrections to non-predetermined values in the higher levels should be calculated.

In the same way, all net taxes on products that are not predetermined can be adjusted to the target value. It may, however, be advisable in a final round to repeat the vertical and horizontal balancing process in which all these adjusted net taxes on products are used as predetermined values, because this may stabilise the system considerably. Non-deductible VAT should, of course, be recalculated to reflect the adjustments at the other levels.

As in the vertical balancing procedure, the computer application must be able to trap adjustments that would lead to improbable values. For the same reasons as mentioned above, automatic balancing will fail to equal supply and use for a number of products. Typically supply is insufficient to cover the predetermined uses of the product. The rows that are left unbalanced in one or more levels can – like the unbalanced columns – be referred to a list of unsolved problems.

The file that is the result of the horizontal balancing procedure will fulfil the requirement that for every product, total use must equal total supply at basic values and that net taxes on products should equal the target.

The sum of all trade and transport margins on the use side can be considered a reasonable estimate of the final value that can be expected with the given trade margin percentages. On the other hand, total VAT may now have moved away from the value to be expected because the column sums at purchasers' prices are no longer equal to the column targets.

Automatic balancing as an iterative process

For illustrative purposes the description of vertical and horizontal balancing has been treated as two separate processes. In reality the whole procedure can be handled by a single job that takes a few minutes on a modern PC with a master file of several ten thousand records. Preparation of the data inputs for the process is far more time consuming. Every time the job is run, new listings of unsolved problems and resulting totals are produced.

When a run is done for the first time with data for a new year, a number of serious problems in the data inputs will usually be revealed. Often problems can be traced back to errors and inconsistencies in data from the statistical sources. Some of these will need to be corrected because they will otherwise cause major distortions in the initial balances.

Before the system is ready for manual balancing, the totals of trade and transport margins and non-deductible VAT should be adjusted within acceptable distance from their respective targets. Adjustments to total trade and transport margins can be made by proportional adjustments to all trade margin percentages of the original unbalanced file before the vertical and horizontal balancing (except in cells with predetermined trade and transport margins). A few systematic guesses will usually bring trade and transport margins within acceptable limits. If total VAT cannot be adjusted to an acceptable level by small adjustments to rates and assumptions used in the calculations, VAT may be left unbalanced at this stage. A search for a specific explanation of the difference may be more appropriate in this case.

In principle, the vertical and horizontal balancing procedure could be repeated in an iterative manner, whereby each iteration would use the result from the preceding one as a starting point. This could, however, be a dangerous method at this early stage, where many problems are still unsolved. Considerable distances between totals and their respective targets have not yet been examined. Some distances between column totals and their targets may even change sign when other problems are corrected.

8.6.2 Manual balancing

The initial version of the master file should, despite the unsolved problems mentioned above, be reasonably close to the final version in its general structure. Now it is up to the responsible persons who are going to manually correct the system to find explanations to these problems, to check the credibility of the results from the automatic balancing and to redistribute products between uses until column totals are within an acceptable distance from their targets.

Organisation of manual balancing

In a detailed commodity-flow with more than 1.000 products, manual balancing can be done within a month by 4 to 6 persons. Each person can be made responsible for an area of the economy. Such areas should ideally consist of a complex of industries and categories of final use with a high degree of interaction. All products and categories of use must belong to a complex to ensure that they all are checked by a responsible person.

Each person is allowed to correct the master file within some limits and restrictions. If only spreadsheets are used in the manual balancing process, it may be necessary to restrict the corrections of each person to his/her area of responsibility. In a system where corrections are entered into a shared updated master-file or database, such a restriction is not needed, but the rules of good conduct among “balancers” should ensure that major changes outside one’s own complex are always negotiated with the “owners” of the other complexes involved, and that information is passed between the relevant persons.

To keep the system manageable, the rules of good conduct should also imply that all products are kept balanced with the identity of total uses = total supply during the balancing process. This also applies to net taxes on products other than VAT. Usually the first task of the balancers is to remove such differences that still exist after the automatic balancing. These differences can have various explanations. As mentioned earlier, serious problems may reveal a need to correct data from primary statistics. However, many remaining differences may be explained by differences in the coding of the same kind of products between production statistics and foreign trade statistics. The problem can then be solved by moving output, imports or exports from one product to another. Since the introduction of “Intrastat”, such problems frequently arise as a result of the automatic grossing up of foreign trade to cover transactions below threshold values.

The balancers will usually be confronted with many well-known problems. To ensure a consistent treatment over time, they should have access to notes showing how the same problems were solved in previous years.

When all independently motivated corrections have been made, differences between column totals and their targets will still exist. The target values will usually not be equally well founded on statistical sources. Some columns should be fully adjusted to the targets, while discrepancies should be allowed elsewhere. For final uses a check on growth rates, preferably at constant prices, may indicate if the column totals are acceptable.

The remaining corrections needed to adjust the column totals are of a more arbitrary nature. Corrections that bring inputs back in line with the results from the “vertical balancing” of intermediate consumption for those industries that have not shown major changes since the preceding year may, if possible, often be preferred.

EDP use in manual balancing

In a modern PC environment, the use of spreadsheets is often the preferred way of handling small and medium sized calculations. A detailed commodity flow system will usually be too big for a pure spreadsheet system. In Denmark, for example, the master file contains of some 50.000 records each with information on all levels from basic to purchasers' values for the system with approximately 2.700 products. Included is information on an optional "pure primary statistics value" without any grossing up, codes that tell which levels are predetermined, which subsystem has produced the original values, and the initials of the person who entered the last correction. The spreadsheet can, nevertheless, be used as an interface to the shared master file under these circumstances. Procedures for extracting data from master file to spreadsheet and transferring corrections from spreadsheet to the updated master file can be made available as macros in the spreadsheet.

When updating a shared master file it is important that no invalid data are allowed as corrections. All corrections should be tested for errors before they are accepted. In a full system with simultaneous balancing of all levels on the uses side, corrections to the cells need not necessarily be specified by the balancers for all levels from basic prices to purchasers' prices. The program that is used to update the master file can carry out the calculation of the missing values from default assumptions. The original trade margin percentages from the master file can be used, and VAT can be recalculated using the updated values.

In the process, the balancers need access to updated information on the state of the system like remaining differences between supply and uses at basic prices by product and the actual distances between column totals and their targets. The "balancing-tools" should at least include easy ways of extracting products and uses to listings and spread-sheets. It should also be possible to extract the same kind of information from the master files of previous years for comparison.

It can be useful for the balancers to have access to constant price data as well as current price data. The supply and use systems at constant prices from previous years will already exist. A preliminary constant price version of the file that is being updated can be computed if price indices are available for all products. This will usually be the case, because such price indices have already been used to inflate last years' master file. An updated file at constant prices could easily be accessed by the tools like those used to extract data from the master file at current prices.

Documentation

Many corrections entered by the balancers will provoke a struggle with references to statistical and other available sources or with common sense considerations. It is important that the considerations behind the solutions are visible to other balancers and that the solutions can be reproduced when the same problems are encountered in following years. Such corrections should be commented on in a systematic way. The corrections entered to remove remaining differences between column totals and their targets may be of a more arbitrary nature, but nevertheless it may be a good idea at least to indicate the purpose of the correction with a comment. Comments may be written together with the actual corrections in spreadsheets that are used as data-input to the corrected master file. A good system of comments is extremely important when targets are chanced as a consequence of inconsistencies exposed during the balancing process, as these corrections will often have consequences for other areas of the national accounts.

8.6.3 Final balancing

When all manual corrections have been made, a complete picture of the accepted column totals should exist. In principle, all totals with binding targets are adjusted to their target values. With appropriate EDP facilities this may not be required. In this case it is sufficient that these totals are brought within a relatively small distance from their targets. When all levels on the uses side are balanced simultaneously, they may still change a little bit in the final balancing of trade and transport margins.

Final balancing of trade and transport margins

In the full system, trade and transport margins can be expected to have changed as a result of manual corrections either because new values have been specified explicitly by the balancers or because the automatic calculation of trade and transport margins have generated changes when products have been moved between uses with different margin percentages. The total use of margins will usually not equal supply even if in balance with the initial version of the system.

A new adjustment to the targets can usually be made by proportional adjustments of non-predetermined margins. If many specific targets for use of margins are present, as may, for instance, be the case for retail trade margins on private consumption, it may, however, be necessary to change some of these targets before balancing is successful. VAT should, of course, be recalculated based on the adjusted values.

After successful balancing of trade and transport margins, differences between column totals and their binding targets should be removed. It is possible to remove these differences with some clever programming.

The cells that can participate in these corrections without causing inconsistencies in the system can be isolated. Corrections that equal column totals to binding targets can be computed by a vertical balancing restricted to these cells. This will create new small differences between supply and uses for many products. These can be removed by a new horizontal distribution among the uses without binding targets. In this process, total trade and transport margins should not be allowed to change and changes to margin percentages should be kept to a minimum. If these calculations should result in significant distortions, the program should issue warnings. Some manual adjustments may still be needed where too little value can be moved without creating significant distortions.

Other ways of removing such differences may be considered. It could be done manually, or one could even decide that a number of small differences are insignificant and should just be accepted.

Virtual industries and their virtual products

When virtual industries exist, they may have been left unbalanced during the manual balancing process. Before automatic final balancing they should be examined. The product mix of each input column should not go against common sense. The total use of the virtual product that is output at basic prices from each virtual industry should in the end be exactly equal to its total input at purchasers' prices. At the start of the final balancing procedure it may be sufficient that this is approximately true, as the column targets for virtual industries could often be treated as non binding at this stage. Final adjustments to the inputs and outputs of virtual industries can be entered manually with other final manual corrections that may be needed to balance the whole system. All virtual industries and products can be eliminated by an automatic calculation when the whole system is balanced.

Final balancing of non-deductible VAT

The total of non-deductible VAT that is a result of the balancing procedure cannot be expected to exactly match the target that is based on government accounts. If only official rates and tax legislation is used in the calculations, the computed VAT total should normally exceed the target. However, to be realistic, the model used to calculate VAT should take into account the expected patterns of tax evasion. A good VAT model should result in a computed total that is not too far from the target. Nevertheless, total computed VAT cannot be expected to reach the target value automatically, so final corrections will be needed. It may be preferable to proportionally adjust VAT in specific columns, where the exact share of VAT liable use is uncertain. A final proportional adjustment of VAT on all products of private consumption can be used to eliminate the remaining difference.

Comparisons between computed "theoretical VAT" and observed total VAT assessments serve as an important check on the level of total VAT liable uses. A sudden change in the distance between the computed total and target may indicate errors in the growth rates of important components of GDP.

Final manual corrections

The more or less automatic procedures used in final balancing of the system will usually bring the system very close to its final form, but a few differences between supply and use will probably remain. Some column totals may also have moved away from their targets in an unacceptable way. As the last step of final balancing, such remaining problems must be detected. They will have to be eliminated by a few final manual corrections.

8.7 Conclusion

Depending on available data and resources, the supply and use system can be very detailed with a large number of products and many industries. A detailed system with more than 1.000 products and a simultaneous balancing of all levels at the use side can be managed with specialised tools and with an organisation that divides the responsibility among a number of persons. On the EDP side, simultaneous balancing of a big system can be facilitated by use of shared file systems and specialised EDP software that does most of the calculation work. On the other hand, a small system may be balanced manually by a few persons using a pure spreadsheet solution that may fulfil the minimum requirements of ESA 1995. As the level of ambition may vary greatly, it is difficult to give precise recommendations on the methods and routines that should be used in each case.

When possible, a system with a high level of detail should be preferred. The supply and use system is not just a way of compiling data for input-output tables. In the balancing process many weaknesses of primary statistics can be detected and corrected. In this way the system serves as a reliable foundation for compiling national accounts. The detailed data base of supply and use tables is a result of confronting most of the available statistical sources in one system. This information can be used for many other purposes than just balancing the national accounts. A balanced macroeconomic data base with detailed information on supply and demand is often more adequate and reliable than the original data from primary statistics.

Supply and use tables at constant prices

chapter 9

eurostat

9.1 Introduction

9.1.1 Purposes of constant price calculation in national accounts

Both from an economic policy and from a modelling point of view, the decomposition of annual value changes into price changes and volume changes are important aspects of the compilation of national accounts. The main objective of national accounts is to provide comprehensive data which can be used for analysing and evaluating the performance of an economy. Data on the major economic flows such as production, household consumption, and capital formation serve as inputs for formulating economic policy. The importance is shown by the extensive data requirements of the European Union for the purpose of economic policy. Intensive use of national accounts data is made within the framework of the EU administration and the Economic and Monetary Union (EMU). Examples are the contributions to the EU budget based on GNP and VAT and the excessive deficit procedure. In these cases, data valued at current prices are used. Additional requirements resulted from the Stability and Growth Pact (SGP), which introduced the use of volume growth rates, and thus constant price estimates, for administrative purposes. This imposes high quality standards on constant price estimates within national accounts.

Furthermore, national accounts data are used to investigate the causal mechanisms within an economy. Estimation of the parameters for macroeconomic models by applying econometric methods requires time series of national accounts data, focussed on annual changes, caused by a combination of two factors: a change in price and a change in quantity often denoted as volume change.

Contrary to data at current prices, data at constant prices cannot be directly observed. They have to be derived from current price data combined with appropriate price and quantity indicators, implying that constant price estimates are more *modelled* than estimates at current prices. This is especially the case in national accounts where nearly all transactions are aggregates and the choice of index formulae can also influence the result of the estimate.

Special attention must be paid to the balancing items of the national accounts, of which GDP is most important. From the output approach, GDP is defined as the difference between total output and total intermediate consumption by all industries. GDP at constant prices can also be calculated as the difference between total output at constant prices and total intermediate consumption at constant prices with the so-called double deflation method. Two methods are normally used in deflating GDP: deflating final uses and the double deflation method for value added. Supply and use tables play an important role in the double deflation method.

More information on constant price calculation can be found in the Eurostat "Handbook on Price and Volume Measures in National Accounts" which deals extensively with aspects related to price and volume components. This manual concentrates on input-output aspects.

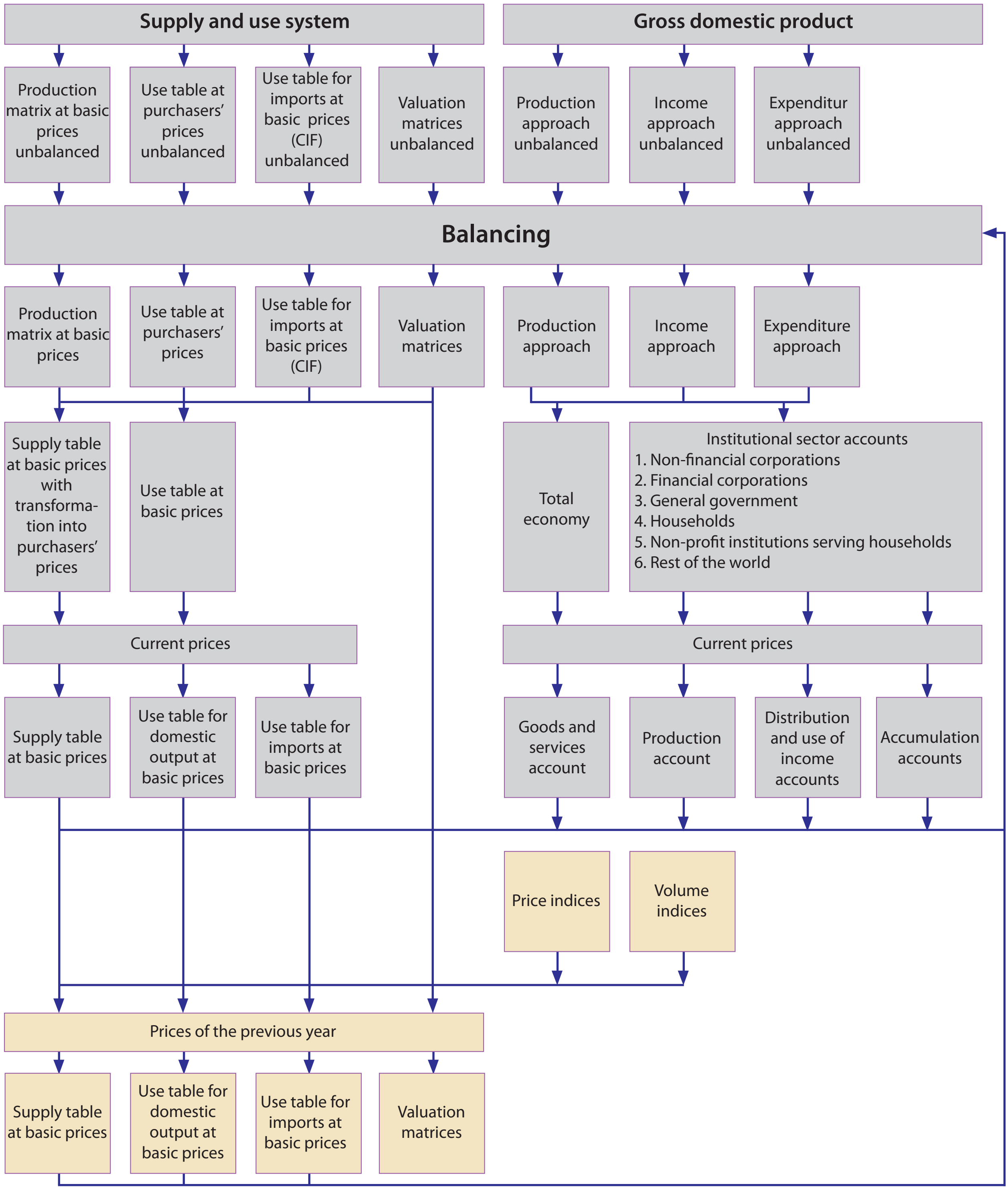
9.1.2 Advantages of the calculation of values at constant prices in a supply and use framework

From the point of the statistical process

The calculation of values at constant prices, volume indices and price indices for the transactions of goods and services in the national accounts is considerably supported by the use of a calculation scheme. Supply and use tables, which are available at current prices, provide an excellent compilation framework for constant price estimates. Firstly, they give a readily available overview of the extensive set of transaction data, price indicators, and volume indicators. Secondly, they provide a check on the numerical consistency, reliability, and plausibility of supply and demand. Thirdly, constant price estimations, when established in an accounting framework give volume indices and deflators of several variables and at different levels of aggregation that are interrelated in a systematic way. Fourthly, in a supply and use system at constant prices, the whole data set can be balanced taking into account the uncertainties of the underlying estimates. Fifthly, the system gives the opportunity to analyse the constant price estimates of values at basic prices in their relation to trade and transport margins, taxes on products, and values at purchaser's prices.

Balancing supply and uses at the same time at current and constant prices is the best option for consistent macroeconomic data. Supply and use tables constitute the optimal framework for this balancing. The corresponding approach is presented in the flow chart of Figure 9.1.

Figure 9.1: Compilation of supply and use table at constant prices



From the point of data provision to users of national accounts

Compiling prices and volumes within an accounting framework of supply and use tables has several advantages. Data on economic growth and inflation at the sectoral level of the total economy can be easily derived. In addition, price changes and volume growth can be derived for industries and final demand categories, offering the opportunity to perform detailed analysis. Productivity analysis is one example. Even in more detail, price and volume changes on a product level are available. Last but certainly not least, the accounting framework offers the opportunity to derive price and volume measures for important balancing items like gross domestic product (GDP).

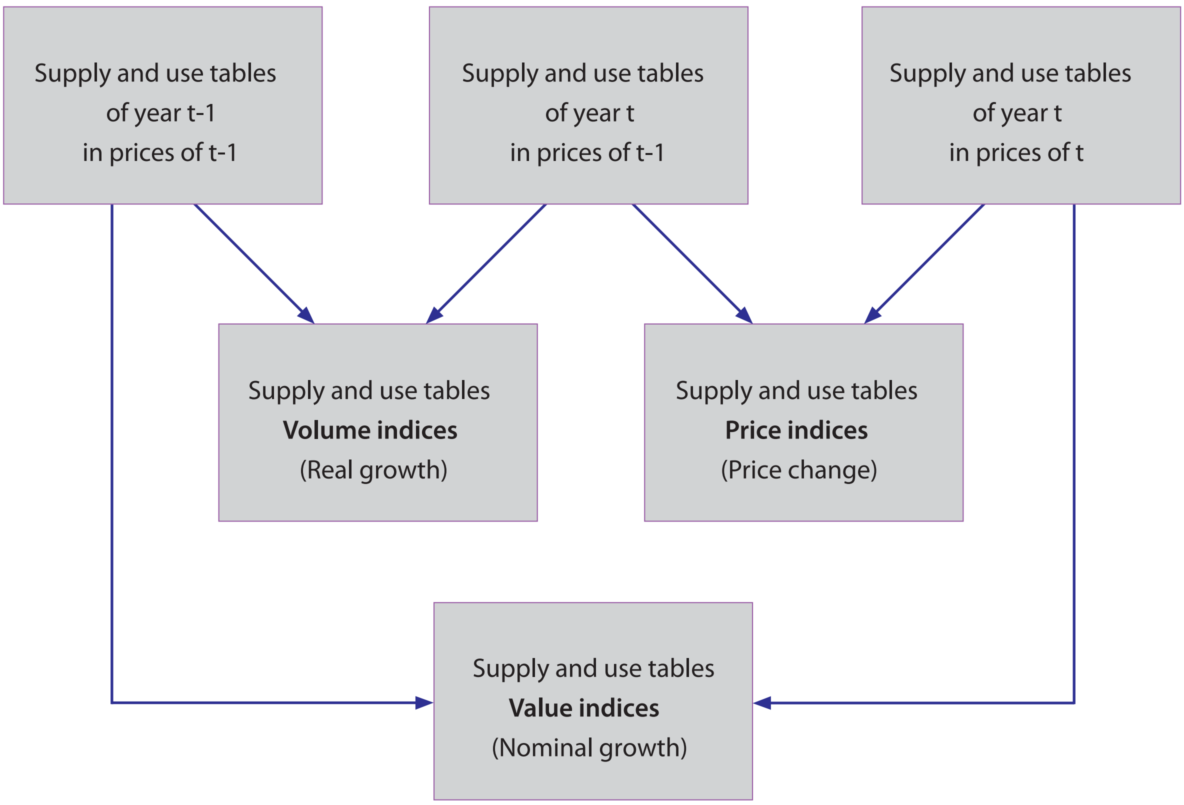
9.1.3 The link between supply and use tables at current and constant prices

There is a direct link between supply and use tables at current prices and supply and use tables at constant prices for two successive years as shown in Figure 9.2.

- The link between the supply and use tables of year t-1 at current prices of t-1 and the supply and use tables of year t at constant prices of t-1 are the supply and use tables with the corresponding volume indices.
- The connecting link between the supply and use tables at current prices of year t and the supply and use tables of year t at constant prices of t-1 are the supply and use tables with the information on price indices.
- Finally, from the supply and use tables at current prices of year t and year t-1 supply and use tables with value indices can be derived.

The supply and use tables with volume indices reflect the real growth rates for all transactions of the economy. The supply and use tables with price indices present the inflation rates and the supply and use tables with value indices show the nominal growth rates of all actual transactions.

Figure 9.2: The link between supply and use tables at current and constant prices



An empirical example for supply and use tables with prices indices, volume indices and value indices is given in the following two tables. Three supply tables and three use tables are required to calculate the price, volume and value indices.

Supply and use tables 2003 at current prices

Supply and use tables 2004 at current prices

Supply and use tables 2004 at prices of the previous year

The results are presented in Table 9.1 and Table 9.2. From these tables refined information on inflation, real growth and nominal growth can be extracted for the supply and use system. It is also possible to identify the nominal GDP, the real GDP and the GDP deflator from the tables.

In Table 9.3 a set of growth rates was derived from the supply and use tables for the gross domestic product at current and constant prices. The gross domestic product was calculated according to the production approach, the income approach, and the expenditure approach. The growth rates report in detail how significant inflation and real growth was in the reported year. The inflation rates and the real growth rates add up to the nominal growth rates. In the example, the nominal GDP grows at the annual rate of +4.0% while the GDP deflator grows by +2.5% and the real GDP by +1.5% per annum. The complete tabulation of supply and use tables with tables for indices and growth rates will help to balance the macroeconomic data at current and constant prices on a product level.

Table 9.1: The supply table at current and constant prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)							IMPORTS				VALUATION		
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Intra EU imports CIF	Extra EU imports CIF	Imports CIF	Total supply at basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Supply table 2004 at current prices (Mio. Euro)														
1	Products of agriculture	7 375				1	6	7 381	1 265	908	2 173	9 555	2 217	- 271	11 501
2	Products of industry	419	78 477	66	1 378	127	207	80 673	35 335	9 138	44 473	125 147	22 636	12 451	160 234
3	Construction work	14	370	26 771	175	65	218	27 613				27 613		808	28 420
4	Trade, hotel, transport services	27	709	114	56 901	310	291	58 353	1 416	492	1 908	60 261	- 24 858	1 988	37 390
5	Private services	35	519	215	2 424	41 981	2 109	47 283	1 489	492	1 980	49 264	2	3 240	52 505
6	Other services		98			2	44 694	44 794	262	98	361	45 154	4	602	45 760
7	Total	7 870	80 173	27 167	60 878	42 485	47 524	266 097	39 767	11 129	50 896	316 993	0	18 818	335 811
8	CIF/FOB adjustments on imports								- 133	- 30	- 163	- 163			- 163
9	Direct purchase abroad by residents								1 380	466	1 847	1 847			1 847
10	Output at basic prices	7 870	80 173	27 167	60 878	42 485	47 524	266 097	41 014	11 565	52 579	318 676	0	18 818	337 494
	Price index (2003 = 100)														
1	Products of agriculture	99.0				100.0	93.3	99.0	101.5	108.8	104.4	100.2	100.2	89.8	100.4
2	Products of industry	94.9	102.3	101.1	99.0	100.3	103.4	102.2	100.6	108.3	102.1	102.1	101.2	102.9	102.1
3	Construction work	104.6	104.5	104.2	104.4	104.5	104.5	104.2	100.0	100.0	100.0	104.2		104.0	104.2
4	Trade, hotel, transport services	100.0	101.6	100.4	101.8	100.6	103.6	101.8	102.4	101.3	102.1	101.8	101.1	103.8	102.4
5	Private services	100.6	101.7	101.8	105.2	102.6	102.1	102.7	103.5	102.9	103.3	102.8	100.0	102.5	102.7
6	Other services		108.8			105.3	103.7	103.7	105.7	104.8	105.4	103.7	105.7	112.2	103.8
7	Total	98.8	102.3	104.1	101.9	102.6	103.6	102.6	100.9	107.7	102.3	102.5		103.4	102.6
8	CIF/FOB adjustments on imports								31.8	35.7	32.5	32.5			32.5
9	Direct purchase abroad by residents								102.4	101.7	102.2	102.2			102.2
10	Output at basic prices	98.8	102.3	104.1	101.9	102.6	103.6	102.6	101.6	108.0	103.0	102.6		103.4	102.7

	Volume index (2003 =100)														
1	Products of agriculture	105.5				183.3	98.4	105.5	101.9	94.4	98.8	104.0	100.7	131.1	102.8
2	Products of industry	106.3	101.3	92.6	103.8	107.0	102.7	101.3	109.0	101.0	107.4	103.4	103.2	100.0	103.1
3	Construction work	65.2	119.3	101.5	79.3	83.3	79.5	101.3	100.0	100.0	100.0	101.3		97.5	101.1
4	Trade, hotel, transport services	100.0	102.3	109.7	103.7	102.8	107.7	103.7	110.7	98.5	107.2	103.8	102.9	104.6	104.5
5	Private services	107.0	100.5	96.3	101.5	102.3	103.2	102.3	103.4	96.5	101.6	102.2	100.0	101.3	102.2
6	Other services		109.5			100.0	102.2	102.2	117.9	96.3	111.1	102.3	109.4	108.4	102.4
7	Total	105.4	101.3	101.5	103.6	102.3	102.2	102.3	108.7	100.0	106.8	103.0		100.4	102.8
8	CIF/FOB adjustments on imports								314.3	280.0	308.0	308.0			308.0
9	Direct purchase abroad by residents								102.6	101.0	102.2	102.2			102.2
10	Output at basic prices	105.4	101.3	101.5	103.6	102.3	102.2	102.3	107.7	99.6	105.9	102.9		100.4	102.7
	Value index (2003 = 100)														
1	Products of agriculture	104.4				183.3	91.8	104.4	103.5	102.8	103.2	104.2	100.9	117.7	103.2
2	Products of industry	100.9	103.5	93.6	102.7	107.3	106.2	103.5	109.7	109.4	109.7	105.6	104.4	102.9	105.2
3	Construction work	68.2	124.7	105.8	82.8	87.1	83.1	105.5	100.0	100.0	100.0	105.5		101.4	105.4
4	Trade, hotel, transport services	100.0	103.9	110.1	105.6	103.4	111.6	105.6	113.3	99.7	109.5	105.7	104.1	108.5	107.0
5	Private services	107.6	102.2	98.0	106.9	105.0	105.4	105.1	107.0	99.2	104.9	105.1	100.0	103.8	105.0
6	Other services		119.1			105.3	106.0	106.1	124.6	100.9	117.1	106.1	115.6	121.6	106.3
7	Total	104.2	103.6	105.7	105.5	105.0	105.9	104.9	109.6	107.8	109.2	105.6		103.9	105.5
8	CIF/FOB adjustments on imports								100.0	100.0	100.0	100.0			100.0
9	Direct purchase abroad by residents								105.0	102.7	104.4	104.4			104.4
10	Output at basic prices	104.2	103.6	105.7	105.5	105.0	105.9	104.9	109.5	107.6	109.1	105.6		103.9	105.5

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Compiling and balancing the supply and use tables at constant prices leads to simultaneous adjustments of the supply and use tables at current prices, which then will be balanced again. Further corrections of the used price indices lead to additional adjustments of the supply and use tables at constant prices. This procedure is repeated until the final supply and use tables at both current and constant prices are acceptable.

Table 9.2: The use table at current and constant prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)							FINAL USES									
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Use table 2004 at current (Mio. Euro)																	
1	Products of agriculture	1 066	4 860		680	38	167	6 811	3 764			382		3	501	42	4 690	11 501
2	Products of industry	2 078	43 772	8 726	10 818	1 781	5 782	72 957	45 651	45	1 474	10 317	107	413	23 570	5 699	87 277	160 234
3	Construction work	100	723	8 005	748	987	304	10 867	111			17 257		185			17 553	28 420
4	Trade, hotel, transport services	185	2 216	273	8 276	1 398	2 182	14 529	18 296		128	361			3 192	884	22 861	37 390
5	Private services	439	5 393	1 280	9 086	11 440	4 198	31 836	14 830	140	122	3 939	1	12	1 129	498	20 670	52 506
6	Other services	33	254	21	461	593	2 425	3 786	10 749	2 674	28 023	326	16	2	134	49	41 974	45 760
7	Total	3 899	57 219	18 306	30 068	16 237	15 058	140 786	93 401	2 859	29 747	32 581	125	615	28 526	7 172	195 025	335 811
8	CIF/ FOB adjustments on exports														- 133	- 30	- 163	- 163
9	Direct purchase abroad by residents								1 847								1 847	1 847
10	Domestic purchas. by non-residents								- 5 784						4 685	1 099		
11	Total	3 899	57 219	18 306	30 068	16 237	15 058	140 786	89 464	2 859	29 747	32 581	125	615	33 078	8 241	196 709	337 494
12	Compensation of employees	785	12 878	5 792	17 556	7 994	26 807	71 812										
13	Other net taxes on production	- 521	- 193	- 58	- 290	289	- 267	- 1 039										
14	Consumption of fixed capital	727	4 828	600	6 253	7 527	3 699	23 634										
15	Operating surplus, net	2 979	5 441	2 528	7 291	10 439	2 226	30 905										
16	Value added at basic prices	3 971	22 955	8 861	30 811	26 249	32 466	125 311										
17	Output at basic prices	7 870	80 173	27 167	60 878	42 485	47 524	266 097										
	Price index (2003 = 100)																	
1	Products of agriculture	100.8	100.6		98.3	104.7	95.4	100.3	100.7		100.0	99.7		- 16.0	97.8	98.1	100.7	100.4
2	Products of industry	103.8	103.3	103.6	102.7	102.5	102.8	103.2	101.5	98.7	98.9	99.4	101.8	102.8	101.0	102.3	101.1	102.1
3	Construction work	100.1	104.2	104.5	104.8	103.9	104.7	104.4	103.3			104.0		103.7	100.0	100.0	104.0	104.2
4	Trade, hotel, transport services	100.8	102.7	103.6	100.7	101.5	102.0	101.4	103.4		102.4	104.4		.0	102.1	99.9	103.1	102.4
5	Private services	96.4	100.7	101.9	101.9	103.9	101.4	102.2	104.0	101.2	100.4	103.7		93.1	98.7	102.0	103.5	102.7
6	Other services	105.5	104.7	105.4	105.2	104.9	103.9	104.3	105.5	101.7	103.4	104.1	105.9	86.4	104.9	105.1	103.8	103.8
7	Total	101.9	102.8	103.9	101.9	103.6	102.4	102.8	102.7	101.7	103.1	102.4	103.1	106.6	101.0	101.9	102.4	102.6
8	CIF/ FOB adjustments on exports														31.8	35.7	32.5	32.5
9	Direct purchase abroad by residents																102.2	102.2
10	Domestic purchas. by non-residents														104.1	104.1	- 344.8	- 344.8
11	Total	101.9	102.8	103.9	101.9	103.6	102.4	102.8	102.6	101.7	103.1	102.4	103.1	106.6	102.3	102.9	102.6	102.7
12	Compensation of employees																	
13	Other net taxes on production																	
14	Consumption of fixed capital	101.4	100.8	100.2	101.0	103.6	102.0	101.9										
15	Operating surplus, net																	
16	Value added at basic prices	95.9	100.9	104.6	101.9	102.1	104.2	102.3										
17	Output at basic prices	98.8	102.3	104.1	101.9	102.6	103.6	102.6										

	Volume index (2003 = 100)																	
1	Products of agriculture	106.4	100.1		104.2	101.7	104.2	101.6	100.3		11.1	121.1		27.6	117.8	112.1	104.6	102.8
2	Products of industry	104.1	101.8	98.8	103.5	103.6	104.1	102.0	102.6	101.6	112.9	105.2	97.5	- 165.2	104.5	97.6	104.0	103.1
3	Construction work	123.9	100.6	107.9	100.5	94.7	103.2	105.5	95.5			98.5		114.9	100.0	100.0	98.6	101.1
4	Trade, hotel, transport services	108.5	104.6	101.2	106.4	102.2	106.6	105.7	102.8		137.8	95.7		64.3	108.6	105.7	103.8	104.5
5	Private services	100.9	100.6	96.4	101.3	104.6	104.8	102.6	102.6	111.2	114.1	93.7		118.2	106.9	128.7	101.6	102.2
6	Other services	106.6	99.2	100.5	106.1	110.8	105.8	106.1	102.2	102.0	101.9	105.4	109.3	- 220.0	119.2	112.8	102.1	102.4
7	Total	105.0	101.6	102.4	103.6	103.8	104.9	102.8	102.5	102.4	102.6	100.2	98.9	- 407.2	105.3	100.5	102.8	102.8
8	CIF/ FOB adjustments on exports														314.3	280.0	308.2	308.2
9	Direct purchase abroad by residents								102.2								102.2	102.2
10	Domestic purchas. by non-residents								101.7						103.5	94.8	- 14.5	- 14.5
11	Total	105.0	101.6	102.4	103.6	103.8	104.9	102.8	102.5	102.4	102.6	100.2	98.9	- 407.5	104.2	99.0	102.7	102.7
12	Compensation of employees																	
13	Other net taxes on production																	
14	Consumption of fixed capital	97.6	104.6	95.5	102.5	101.8	102.7	102.4										
15	Operating surplus, net																	
16	Value added at basic prices	105.9	100.7	99.7	103.5	101.4	100.9	101.7										
17	Output at basic prices	105.4	101.3	101.5	103.6	102.3	102.2	102.3										
	Value index (2003 = 100)																	
1	Products of agriculture	107.2	100.7		102.4	106.5	99.5	101.9	101.0		11.1	120.7		- 4.4	115.2	110.0	105.3	103.2
2	Products of industry	108.0	105.2	102.4	106.3	106.2	107.1	105.3	104.1	100.2	111.6	104.6	99.3	- 169.8	105.6	99.8	105.2	105.2
3	Construction work	124.0	104.8	112.7	105.3	98.4	108.1	110.1	98.6			102.5		119.2	100.0	100.0	102.6	105.4
4	Trade, hotel, transport services	109.4	107.4	104.9	107.1	103.8	108.8	107.1	106.3		141.1	99.9		.0	110.8	105.6	106.9	107.0
5	Private services	97.2	101.2	98.3	103.3	108.7	106.2	104.9	106.6	112.6	114.6	97.2		110.0	105.5	131.3	105.2	105.0
6	Other services	112.5	103.9	106.0	111.6	116.2	109.9	110.6	107.8	103.7	105.3	109.8	115.7	- 190.0	125.0	118.6	105.9	106.3
7	Total	106.9	104.5	106.4	105.6	107.5	107.4	105.7	105.2	104.1	105.8	102.7	102.0	- 434.1	106.4	102.4	105.3	105.5
8	CIF/ FOB adjustments on exports													.0	100.0	100.0	100.1	100.1
9	Direct purchase abroad by residents								104.4								104.4	104.4
10	Domestic purchas. by non-residents								105.9						107.7	98.7	50.0	50.0
11	Total	106.9	104.5	106.4	105.6	107.5	107.4	105.7	105.2	104.1	105.8	102.7	102.0	- 434.4	106.6	101.9	105.3	105.5
12	Compensation of employees	103.3	100.9	102.4	104.1	103.9	104.2	103.4										
13	Other net taxes on production	120.5	- 146.6	- 137.6	171.7	163.8	116.5	216.8										
14	Consumption of fixed capital	99.0	105.4	95.7	103.6	105.5	104.7	104.3										
15	Operating surplus, net	104.6	106.0	116.1	112.4	100.8	120.8	107.2										
16	Value added at basic prices	101.6	101.5	104.2	105.4	103.5	105.2	104.0										
17	Output at basic prices	104.2	103.6	105.7	105.5	105.0	105.9	104.9										

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Table 9.3: Gross domestic product at current and constant prices

Production approach		Income approach		Expenditure approach	
GROSS DOMESTIC PRODUCT				**2004 at current prices (Millions of euro)**	
Total output at basic prices	266 097	Compensation of employees	71 812	Household final consumption expenditure	89 464
- Intermediate consumption	- 140 786	+ Other net taxes on production	- 1 039	+ NPISH final consumption expenditure	2 859
		+ Capital consumption	23 634	+ Government consumption expenditure	29 747
		+ Net operating surplus	30 905	+ Gross fixed capital formation	32 581
				+ Changes in inventories	125
= Value added at basic prices	125 311	= Value added at basic prices	125 311	+ Acquisitions less disposals of valuables	615
				+ Exports of goods and services	41 318
+ Taxes less subsidies on products	18 818	+ Taxes less subsidies on products	18 818	- Imports of goods and services	- 52 579
= Gross domestic product	144 129	= Gross domestic product	144 129	= Gross domestic product	144 129
INFLATION				**Annual change of prices in percent**	
Total output at basic prices	2.6	Compensation of employees		Household final consumption expenditure	2.6
- Intermediate consumption	2.8	+ Other net taxes on production		+ NPISH final consumption expenditure	1.7
		+ Capital consumption	1.9	+ Government consumption expenditure	3.1
		+ Net operating surplus		+ Gross fixed capital formation	2.4
				+ Changes in inventories	3.1
= Value added at basic prices	2.3	= Value added at basic prices	2.3	+ Acquisitions less disposals of valuables	6.6
				+ Exports of goods and services	2.4
+ Taxes less subsidies on products	3.4	+ Taxes less subsidies on products	3.4	- Imports of goods and services	3.0
= Gross domestic product	2.5	= Gross domestic product	2.5	= Gross domestic product	2.5
REAL GROWTH				**Annual real growth rates in percent**	
Total output at basic prices	2.3	Compensation of employees		Household final consumption expenditure	2.5
- Intermediate consumption	2.8	+ Other net taxes on production		+ NPISH final consumption expenditure	2.4
		+ Capital consumption	2.4	+ Government consumption expenditure	2.6
		+ Net operating surplus		+ Gross fixed capital formation	0.2
				+ Changes in inventories	-1.1
= Value added at basic prices	1.7	= Value added at basic prices	1.7	+ Acquisitions less disposals of valuables	-507.5
				+ Exports of goods and services	3.1
+ Taxes less subsidies on products	0.4	+ Taxes less subsidies on products	0.4	- Imports of goods and services	5.9
= Gross domestic product	1.5	= Gross domestic product	1.5	= Gross domestic product	1.5
NOMINAL GROWTH				**Annual nominal growth rates in percent**	
Total output at basic prices	4.9	Compensation of employees		Household final consumption expenditure	5.2
- Intermediate consumption	5.7	+ Other net taxes on production		+ NPISH final consumption expenditure	4.1
		+ Capital consumption	4.3	+ Government consumption expenditure	5.8
		+ Net operating surplus		+ Gross fixed capital formation	2.7
				+ Changes in inventories	2.0
= Value added at basic prices	4.0	= Value added at basic prices	4.0	+ Acquisitions less disposals of valuables	-534.4
				+ Exports of goods and services	5.6
+ Taxes less subsidies on products	3.9	+ Taxes less subsidies on products	3.9	- Imports of goods and services	9.1
= Gross domestic product	4.0	= Gross domestic product	4.0	= Gross domestic product	4.0

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The level of detail in the balanced supply and use tables at constant prices is similar to the level of details of the supply and use tables at current prices. All definitions and relationships of the current price supply and use tables are also maintained in the constant price supply and use tables. An integrated set of price and volume measures are compiled within the framework of detailed annual supply and use tables at current and constant prices.

9.2 The role and choice of price and volume indicators

9.2.1 The object of measurement and the choice of indicators

Price and volume indices are derived from price and quantity changes of separate products at a low level of aggregation. Generally speaking, the lower the level of aggregation, the better the requirement of homogeneity will be fulfilled. Homogeneity is necessary to assure that, according to the ESA standards, quality changes are included in the volume component of the annual value changes.

For the sake of reliability, an important and decisive question is how to measure price and quantity changes at the detailed product level. Or, in other words, how to define which price and quantity data are appropriate indicators to apply for the calculation of price and volume indices.

Before starting the observation of indicators, it is necessary to first define the object of measurement, i.e. in case of production, questioning what the true output of a certain productive activity actually is. At first sight, this seems to be asking for the sake of asking, as for most production processes it is quite clear what the output is and one has to observe the prices and quantities of this output. However, in some particular areas, an exact definition of what is produced is more difficult. In the case of market production, examples are the banking and the insurance sector. In the case of non-market production, government production, education services and medical services are good examples. In this situation, it is tempting to apply any quantity or price indicator which is available, even if the indicators refer to an input or to an intermediate factor in the production process. However, such indicators do not provide good price or volume indices for the deflation of output. These kinds of mistakes are prevented by firstly defining what the true products of an activity are and then trying to find indicators directly related to these products.

9.2.2 The link between value, price and volume in the collection of data

Different methods to separate value changes in price and volume changes

In an imaginary, ideal statistical world, integral information on values, quantities, and prices of transactions would be available. However, the real world is different. The acquisition of data is difficult and expensive. Fortunately, for good estimates at constant prices we do not need all of the mentioned information. If for two of the three categories (values, quantities, prices) appropriate data are available, the third can be derived.

Box 9.1: Two examples

The main service rendered by hospitals is treating patients with various diseases. Appropriate indicators are the numbers of complete treatments of patients (classified according to kind of disease, age of the patients, etc.) and the prices (in case of market production by hospitals) of complete treatments. In spite of their frequent availability, indicators like the number of nursing days and the prices of nursing days are not appropriate indicators for the measurement of the volume of the output of medical hospitals. The reason is that nursing is not the true purpose of the activities of hospitals but an intermediate factor in the production of the true service: i.e. the treatment of patients. The use of indicators like nursing days can cause serious biases in e.g. calculations of the productivity of hospitals.

True services rendered by police activity are e.g. advancing the safety of the citizens and enforcing the law. This purpose can be achieved in different ways among which provision of information on dangerous situations, prevention by intensive observation and surveillance, and discouraging by fining. Finding good quantity indicators in this case is very difficult. If, for instance, the number of fines (or the number of arrests) is available, it is alluring to use that information as an indicator for the output of the police force. However, this would give a wrong notion of the real output, since a high amount of fines would not always mean that the police is operating well. It is possible that the same quality of service can be reached by more prevention measures and fewer fines. Applying the number of fines as an indicator would ignore this.

Standard price method

Often values at current prices are available, from production surveys, for example. What remains is the question of how to separate the change in value into a volume and a price change. In order to do this, information has to be obtained on either prices or quantities. Still, the information problem has not been solved due to the fact that mostly integral information, neither on prices nor on quantities, is available. Therefore, approximations have to be made based on limited information. In such cases, one has to keep in mind that limited price data and limited quantity data do not provide the same possibilities.

When applying limited information, it is an essential requirement that the derived price index or volume index is representative for the non-observed transactions. It may be expected that price information from a sample with a certain size is more representative than quantity information from a sample of the same size. This statement is based on the consideration that if there is a competitive market for a homogeneous product there will be a tendency to one price for the total supply of that product. In that case, a relatively small sample will be sufficient for observing the price and price changes of the total supply of that product.

However, changes of quantities are less liable to such equalising tendencies. It is true that in an expanding market all producers will try to increase their supply but the realisation will depend of restrictive factors such as production capacity and financing facilities. Along with fast growers there will be slow growers and, maybe, even shrinking producers. This means that in order to obtain reliable estimates or samples for quantity, the information has to be extensive. In most cases, samples appropriate for quantity information will be much more expensive than samples for appropriate price information.

As a consequence, it is common practice to derive price indices from price samples and afterwards derive volume indices and values at constant prices by combining values at current prices and price indices. This approximation method is, in many cases, efficient and cost saving. The reliability of the result depends on the extent to which equalising tendencies on the markets exist in reality.

Quantity method

Although the standard price method can be applied for many goods and services, in many cases observation of prices has not yet been realised and will not be in the near future. Furthermore, in particular cases, owing to the nature of the definition and measurement of output at current prices, direct observation of appropriate prices is not possible. Well-known examples are non-market services and services of banks (FISIM) and insurance companies. If prices are not available, alternative methods must be found. A widespread current alternative is to apply the input method.

One promising alternative for some services is the use of quantity information. In the previous section, it was stated that for reliable quantity indicators a large amount of data is required which would lead to high costs. However, for some industries, mostly object of government interference (e.g. public transport, medical services, and culture) or government supervision (e.g. banking, insurance), a lot of detailed quantity data are collected by the statistical office or government agencies. Since this information has already been collected for other purposes, the high cost impediment does not exist here.

Values derived from price and quantity

There are still production areas where value information is not available although perhaps less than in the past. In those cases where representative quantity information is available in combination with representative price indices, values at current prices can be derived by extrapolation of the values for the previous year. An example is agriculture, where a high amount of quantity and price information is often collected.

Relation between current price and constant price measurement of non-market production

The value at current prices of non-market services, by definition, equals the sum of the costs of inputs. In discussions on the deflation of non-market services it is sometimes stated that there has to be a strong relation between the computation methods of values at current and at constant prices. It is argued that this should also be so for output at constant prices and therefore that an input method should be applied here. Accepting this statement introduces a considerable restraint on the estimation of volume and price indices for non-market services. Independent estimates of value added at constant prices and productivity changes are not possible if the input method is used. On account of the high amount of non-market services, estimates of the volume growth of macroeconomic variables like GDP are also liable to be biased if a high amount of non-market services is included.

Furthermore, it can be argued that equal methods for constant and current prices are not required. The prescribed method for current price estimates can be considered as an emergency solution arising from the impossibility to observe the value of non-market production directly. If better methods are available for constant price estimates, there is no reason not to apply them. An additional objection is that estimates at constant prices are often subordinate to estimates at current prices.

Since, in the case of non-market services, prices are non-existent, quantity methods have to be applied.

Practical requirements for price and quantity indicators

Price and quantity indicators have to meet a number of practical requirements in order to be used to estimate price and volume indices. The requirements are defined in relation to output. However, they are also relevant to all other transactions in goods and services.

- The prices and quantities should *relate directly to output*. This means that they should refer to complete end products and not to contributory activities or to contributory intermediate or primary inputs. In the case of prices, they also have to refer to the right valuation: for output valuation at basic prices.
- The prices and quantities should have *sufficient stratification*: This means that different prices and quantities should be available for all different product groups making up output.
- Product groups should have *sufficient homogeneity*. This requirement will be fully met if there is only one product in a product group. If there is more than one product within a product group, an additional requirement is that the composition of the product group does not change over time.
- The prices and quantities should be *sufficiently representative* of the product group. Usually, prices and quantities available do not cover all products of the product group and/or are based on a sample. Changes in the prices/quantities that are observed should be representative of changes in the prices and quantities that are not observed.
- Changes in values resulting from changes of quality should be excluded from the price index and included in the volume index. The volume index = quantity index x quality index.

Generally, the requirements are the same for both prices and quantities.

9.2.3 Aggregation levels for the deflation of goods and services

General considerations

Deflation should be carried out at the lowest possible level of aggregation of transactions. The following arguments in favour of a low aggregation level should be mentioned.

- Generally speaking, price and volume indicators will be more representative at a low level of aggregation of transactions.
- The requirement of a proper measurement of quality change is fulfilled to a higher degree when transactions are more homogeneous. Changes in the composition of the supply or use of a product group can be taken into account.
- Available price indices from price statistics are often of the Laspeyres type. The objection that they are applied in a Paasche environment is less severe if they are used at a low level of aggregation of the transactions since indices at a higher aggregation level can be derived by applying the Paasche formula.

Aggregation levels for the derivation of constant prices

Even if the classification of products and industries in the existing supply and use tables is highly detailed, most entries will be aggregates. For the reasons mentioned above, it is recommended that for every entry, deflation will be carried out in as much detail as possible. Constraints are the level of aggregation of the underlying values at current prices and the degree of detail of the available price and quantity indicators.

Aggregation levels for the balancing of transactions at constant prices

Generally speaking, balancing of the supply and use of a product at constant prices is easier when the number of products distinguished in the supply and use tables is higher. In addition, the quality of the balanced results will be higher. This is especially true when price and volume indicators are less reliable or even missing. This is illustrated in Box 9.2 with a fictitious example.

9.3 Weighting

9.3.1 Choice of index number formulae

In order to calculate price and volume measures, a number of methodological choices must be made. Firstly, a choice must be made which index number formulae will be applied. Secondly, a choice must be made between a fixed base year and an annually changing base year. These issues will be discussed in this section.

Box 9.2: Product groups for machines and spare parts

Suppose a product group includes complete machines as well as spare parts. The former are part of fixed capital information; the latter are part of intermediate consumption by industries. Suppose that separate price indices are available for the supply of machines and spare parts but direct price indicators for fixed capital formation and intermediate consumption are not available. In such a situation proxy deflators have to be "borrowed" from the supply side. Especially when working under pressure of time limits, different balancing results can occur depending on the aggregation level in the supply and use tables.

	Supply	Use	
	Total	Intermediate consumption	Fixed capital formation
Case I: Separate commodity groups for machines and spare parts			
Machines			
Value at current prices t	800.00		800.00
Price index	110.00		110.00
Value at constant prices	727.00		727.00
Volume index	103.90		103.90
Value at current prices t-1	700.00		700.00
Spare parts			
Value at current prices t	500.00	500.00	
Price index	105.00	105.00	
Value at constant prices	476.00	476.00	
Volume index	105.80	105.80	
Value at current prices t-1	450.00	450.00	
Total			
Value at current prices t-1	1300.00	500.00	800.00
Price index	108.10	105.00	110.00
Value at constant prices	1203.00	476.00	727.00
Volume index	104.60	105.80	103.90
Value at current prices t-1	1150.00	450.00	700.00
Case II: One commodity group for machines and spare parts			
Total			
Value at current prices t-1	1300.00	500.00	800.00
Price index	108.10	108.10	108.10
Value at constant prices	1203.00	463.00	740.00
Volume index	104.60	102.90	105.70
Value at current prices t-1	1150.00	450.00	700.00

In this example, it seems that in the case of only one product group intermediate consumption at constant prices would have been underestimated and gross domestic product as well as fixed capital formation would have been overestimated.

Different index formulae can be applied using different weighting schemes. It is beyond the scope of this manual to discuss in depth the theoretical and practical considerations with respect to this choice.

Economic theory suggests that an index formula that assigns equal weights to the current year and the base year is to be preferred. This is one of the reasons why the SNA and ESA show a preference for so-called superlative indices, like Tornqvist and Fisher. However, this preference is not strongly marked. Although the superlative indices have a number of attractions, it should be noted that they have also disadvantages:

- The superlative indices are demanding in their data requirements and will increase the work burden significantly, possibly leading to delays in publication.
- The superlative indices are less easy to understand than Laspeyres and Paasche indices.
- The superlative indices are not additively consistent, which is a serious constraint when applied in an accounting framework. This even holds for the most elementary case of year to year changes.

From a practical point of view a number of requirements can be imposed on the index numbers:

- The applied index formulae should be a good approximation of the changes obtained by the superlative indices.
- A change in value must be divided into a price change and a volume change without residual.
- Values at constant prices for aggregates should equal the sum of values at constant prices of constituent parts, applying the same index formulae.
- Additionally it is often required that the index formulae are relatively straightforward and easy to interpret for users

Imposing these requirements limits the number of possibilities in the choice of index number formulae. Most widely applied is the use of a combination of a Laspeyres volume index and a Paasche price index, especially when constant price calculation is carried out in supply and use tables. The reason is that checks on the consistency of the underlying data can only be easily carried out if the balancing identities that hold for the supply and use tables at current prices also hold for the tables at constant prices. This means that after balancing:

For every product total, supply equals total use and for every industry total output equals total intermediate consumption plus value added.

Total supply at constant prices = Total use at constant prices

Total output at constant prices = Total intermediate consumption at constant prices + Total value added at constant prices

These requirements can only be met with the application of the Laspeyres volume index formula and the Paasche price index formula.

Laspeyres volume index

$$\mathrm{Lq} = \frac{\sum p_0 q_t}{\sum p_0 q_0} = \frac{\sum p_0 q_0 \frac{q_t}{q_0}}{\sum p_0 q_0}$$

Paasche price index

$$\mathrm{Pp} = \frac{\sum p_t q_t}{\sum p_0 q_t} = \frac{\sum p_t q_t}{\sum p_t q_t / \frac{p_t}{p_0}}$$

It can be easily shown that the decomposition of value changes in volume and price changes is without residual.

$$Pv = \frac{\sum p_t q_t}{\sum p_0 q_0} = Lq * Pp$$

Deflation of values at current prices by means of a Paasche price index yields:

$$\text{Pv / Pp} = \sum p_t q_t \,/\, \frac{\sum p_t q_t}{\sum p_0 q_t} = \sum p_0 q_t$$

The interpretation of this result is quite clear. The derived constant price values use the previous year's prices.

Characteristic for the Laspeyres volume index is that the volume changes of individual goods are weighted together with the value in a previous year (the "base year"). Characteristic for the Paasche price index is that the price changes of individual goods are weighted together with their value in the current year. The deflated values derived with this index formula combination can easily be explained as "values in prices of the base year".

9.3.2 Choice of base year

Applying the Laspeyres volume index number formula, volume changes are weighted with the values in a "base year". The question arises which year should be chosen as the base year. Generally speaking there is a choice between a fixed base year and a changing base year.

With the method of fixed weights for a series of years, the weights are derived from a single year in the past. An advantage of this method is that in longer series of values at constant prices, deflated parts of aggregates exactly add up to the deflated aggregate. However, a very serious disadvantage is that volume changes of aggregates are calculated with outdated weights. This disadvantage is especially severe when relative prices change rapidly. As a result, economic growth is often significantly overestimated.

Applying a changing base year means that weights change every year and are usually derived from the previous year. Since those weights are more up-to-date, a better approximation of the "real world" volume changes is obtained than with the method of fixed weights. Time series results can be obtained by multiplying separately estimated year-to-year volume indices: this is called "chaining". An important advantage of the chaining method is that the above mentioned overestimation of growth rates is avoided. There is also a disadvantage: in time series at constant prices the deflated parts of an aggregate no longer exactly add up to the deflated aggregate. As a result "mathematical discrepancies" will appear that cannot be removed without disturbing the underlying "actual" volume and price movements.

The contrast between fixed weight methods and changing weight methods is to a certain extent not absolute but exists only in relative terms. Also, the application of fixed weights periodically asks for changing the weights to another base year. In chaining the sub-series the non-additivity problem will also appear.

9.3.3 Some practical results of different index number formulae and base years

Table 9.4 gives the results of alternative estimates of the growth rates of GDP, exports and consumption expenditure of households. Table 9.5 gives the corresponding time series of volume indices.

When discussing the results, the chain Fisher volume indices are considered as a "standard" with which other results are compared.

The results in Table 9.4 show that most substantial divergences occur with Laspeyres fixed weight indices. The Laspeyres, Fisher and Paasche chain type indices yield comparable results in most cases and the differences between the Paasche fixed weight and chain indices are, generally speaking, much smaller than between the Laspeyres fixed weight and chain indices. A remarkable, and for statistical practice very important, conclusion which can be drawn from Table 9.4 is that the Laspeyres chain indices provide good approximations of the "ideal" Fisher chain indices and that the Laspeyres fixed weight indices do so less or, sometimes, not at all. This is especially important for the cases where the differences between Laspeyres and Paasche fixed weight indices and between the Laspeyres fixed weight index and the Laspeyres chain index are substantial. See: GDP (1988 and 1993), Consumption of households (1991), and Exports (1988, 1989 and 1993).

Table 9.4: Growth rates for macroeconomic variables with different index number formulae

Annual growth rates in %

	Laspeyres (weights 1986)	Laspeyres (chain)	Fisher (chain)	Paasche (chain)	Paasche (weights t. 1986)
Gross Domestic Product (market prices)					
1987	1.4	1.4	1.4	1.4	1.4
1988	3.4	2.6	2.6	2.6	2.7
1989	4.8	4.7	4.6	4.4	4.6
1990	4.2	4.1	4	3.9	3.5
1991	2.3	2.3	2.2	2.2	2
1992	2	2	2	2	2
1993	1.3	0.8	0.8	0.8	0.7
Consumption expenditure of households					
1987	2.7	2.7	2.7	2.7	2.7
1988	0.7	0.8	0.8	0.8	0.8
1989	3.5	3.5	3.5	3.5	3.5
1990	4.2	4.2	4.2	4.2	4.1
1991	3.3	3.1	3.1	3.1	2.9
1992	2.5	2.5	2.5	2.5	2.4
1993	1.1	1	1	0.9	0.9
Exports					
1987	4	4	3.9	3.7	3.7
1988	10.3	9	9	9	9.1
1989	6.8	6.6	6.5	6.3	6.2
1990	5.4	5.3	5.3	5.2	5
1991	4.9	4.7	4.7	4.6	4.7
1992	3.1	2.9	2.8	2.8	2.9
1993	2.1	1.5	1.4	1.4	1.4

Netherlands 1986 - 1993

Generally speaking, the results in Table 9.4 also bear out the statement of SNA 1993 that Laspeyres volume indices yield higher growth rates than Paasche volume indices and that the differences between the Laspeyres and Paasche chain indices are smaller than between the corresponding fixed weight indices.

Table 9.5 presents the time series of volume indices corresponding with the annual growth rates in Table 9.4. It is not surprising that the conclusions that can be drawn from the results in Table 9.4 and Table 9.5 are quite similar.

9.3.4 Weighting detailed price and quantity information to form a volume indicator at the aggregation level of the supply table

In particular parts of the service sector, values at current prices are only available at rather high levels of aggregation. As a result, the product classification in supply and use tables is necessarily heterogeneous, which hampers good estimates of price and volume indices.

In some cases, a proxy solution for this problem exists. This is the case when more detailed price or quantity information can be found. Weighting the more detailed data will result in a quantity indicator at the product level of the supply and use tables. Since values at current prices of t-1 are not available at the detailed level, alternative weights have to be found. Which weights should be used is hard to define and will depend on the industry. Only one requirement has to be fulfilled: the weighted quantity indicators have to be more appropriate than the unweighted indicators. An example is given below.

Table 9.5: Time series of volume indices according to different index number formulae

1986 = 100

	Laspeyres (weights 1986)	Laspeyres (chain)	Fisher (chain)	Paasche (chain)	Paasche (weights t, 1986)
Gross Domestic Product (market prices)					
1987	101.4	101.4	101.4	101.4	101.4
1988	104.9	104.1	104	104	104.1
1989	109.9	108.9	108.8	108.6	108.9
1990	114.5	113.4	113.1	112.8	112.7
1991	117.1	116	115.6	115.3	115
1992	119.5	118.3	117.9	117.5	117.3
1993	121	119.2	118.9	118.5	118.2
Consumption expenditure of households					
1987	102.7	102.7	102.7	102.7	102.7
1988	103.5	103.6	103.6	103.6	103.5
1989	107.1	107.2	107.2	107.1	107.1
1990	111.6	111.7	111.7	111.6	111.5
1991	115.3	115.2	115.1	115	114.7
1992	118.2	118.1	118	117.9	117.4
1993	119.5	119.3	119.2	119.1	118.5
Exports					
1987	104	104	103.9	103.7	103.7
1988	114.8	113.4	113.2	113	113.1
1989	122.6	120.9	120.5	120.1	120.1
1990	129.1	127.4	126.9	126.4	126.1
1991	135.4	133.4	132.8	132.2	132
1992	139.5	137.2	136.6	135.9	135.9
1993	142.5	139.3	138.5	137.8	137.7

Netherlands 1986 - 1993

Suppose that services provided by homes for the elderly is only one product group in the supply table. The reason is that the value of output at current prices is only available at that aggregation level. The output of homes for the elderly is often heterogeneous since different residents require different levels of care. A candidate volume indicator for the output is the number of resident days. However, the indicator would be more appropriate if one could take into account the differences in care needs. Sometimes, in social statistics, residents are classified by "intensiveness of care". Weighting the quantity indices for the separate care categories will result in a better volume index. Candidate weights are the costs per resident per care category. If this information is not available, perhaps, as a last resort, expert guesses could be helpful.

9.4 Compiling supply and use at current and constant prices

9.4.1 Introduction

ESA 1995 requires the compilation of supply and use tables at current prices as well as at constant prices. In practice this process can be organised in two ways. One way can be described as follows. Firstly, complete the compilation process at current prices (data collection, adjusting the data and balancing). After this task has been accomplished, the tables are deflated and, finally, the values at constant prices are balanced. This method could be referred to as the *sequential* *approach*. The alternative is to balance the tables both at current and at constant prices "at the same time". At the end of the compilation process, tables at current as well as at constant prices are available. This method is referred to as the *simultaneous approach*. The advantages and disadvantages of the simultaneous and the sequential approach are discussed in this section.

There are a number of reasons why the sequential approach can be preferred to the simultaneous one. The most important is probably that it is less complicated because one has only to deal with values at current prices during balancing. A second reason to choose the sequential method is the lack of reliable price data on a sufficiently detailed level. In that case, a possible way of organising the statistical process is to compile the tables first at current prices, aggregate data, deflate and finally balance the tables at constant prices. However, the major disadvantage of a sequential approach is that problems encountered while compiling a constant price table sometimes make it necessary to make changes in the current price tables that have already been finished and perhaps published.

The main advantage of the simultaneous approach is that it gives the possibility of analysing value, price and volume indices in relation to each other. The outcome of the analysis may affect constant as well as current price data. In other words, all three indices must give a plausible picture. This clearly improves the quality of the outcome of the balancing process. It must also be mentioned that the simultaneous approach can be useful not only in the balancing phase but also in the phase in which basic data are prepared for national accounts purposes. The approach offers the opportunity to check the data by comparing price and volume indices before they are entered in the system of supply and use tables. Simultaneous balancing at current and constant prices may result in a different allocation of corrections than balancing at current prices only.

Irrespective of the way the compilation process of supply and use matrices is organised, it can be summed up in a column-row-column scheme.

In the first step, work is concentrated on the *columns*. Columns refer to the industries and final consumption categories. The system has to be filled with data from a variety of sources. Data has to be collected, made complete and adjusted to national accounts standards.

The second step is the start of the balancing process. At this stage, the system contains a full description at product and activity level. Now the focus is on the *rows* or product groups. Supply and use are to be balanced at product level. The decisions made during this step have an effect on production and intermediate consumption of the industries and, as a result, on their value added.

In the third step the attention is again on the *columns,* more specifically on the value added by industry. When the changes of value added are unacceptably large, one has to go back to step two to make the necessary corrections. To a certain extent it is an iterative process. However, if in step two large corrections on a certain product group are necessary, it is wise not to wait until all rows are balanced but rather check their effect on the value added immediately.

9.4.2 Simultaneous compilation of current and constant prices

From source statistics to supply and use tables (first step in the column-row-columns scheme)

A simultaneous system of supply and use tables asks special requirements of the data set. It is not sufficient to collect the data at current prices. Before the data are entered in the system they must be deflated. So, an important step is estimating data in prices of the previous year. Every transaction, output, intermediate and final consumption must be described in terms of product groups not only at current prices but also at prices of the previous year. In order to calculate indices, the system requires also values at current prices of the previous year. For every entry in the supply and use table, three values must be available: a value for t at prices of t-1 and a value at current prices for year t-1 and t. The information can be presented in the scheme of Table 9.6:

Table 9.6: Required data for every entry

Description	Data	Description	Data
t at current prices	525	Price index	102.9
t at constant prices of t-1	510	Volume index	102.0
t-1 at current prices	500	Value index	105.0

This set of data allows the national accountant to double-check the data on consistency: even if the results at current prices look plausible, analysis of the volume and price data can show serious problems.

An important check is the comparison between changes in the volume of output by industry and its intermediate consumption and value added. When prices change rather rapidly, it is evident that analysis in volume terms is to be preferred.

Box 9.3: Example

Price and volume changes of domestic production and export can be compared as is done in the simplified example below. This example abstracts from margins, taxes and subsidies and imports. Supply minus use shows the discrepancies between supply (domestic production) and use (export and other users) at current and at constant prices.

	Supply minus use	Domestic production	Exports	Other uses		Domestic production	Exports	Other uses
Value t at curent prices	-10	525	420	115	Price index	102.9	100.0	103.6
Value t at constant prices of t-1	-21	510	420	111	Volume index	102.0	105.0	111.0
Value t-1 at current prices	0	500	400	100	Value index	105.0	105.0	115.0

In this example there is a discrepancy at constant prices as well as at current prices. The first step is to form an opinion about the reliability of the data. In this case data on domestic production and exports, both at current prices, are considered reliable. So a sensible solution is to adjust "other uses". If the price index (102.9) is considered to be correct, the adjustment should be made both at current and constant prices. This results in the following situation.

	Supply minus use	Domestic production	Exports	Other uses		Domestic production	Exports	Other uses
Value t at curent prices	0	525	420	105	Price index	102.9	100.0	102.9
Value t at constant prices of t-1	-12	510	420	102	Volume index	102.0	105.0	102.0
Value t-1 at current prices	0	500	400	100	Value index	105.0	105.0	105.0

The discrepancy at current prices has been eliminated but at constant prices it still exists. Assuming that the price of domestic production and the prices of the other uses are reliable figures in this example and assuming further that the difference between the volume index of domestic production and export should not be too large, the balancing results in an adjustment of the price of the export and a minor adjustment of other uses.

	Supply minus use	Domestic production	Exports	Other uses		Domestic production	Exports	Other uses
Value t at curent prices	0	525	420	105	Price index	102.9	102.7	104.0
Value t at constant prices of t-1	0	510	409	101	Volume index	102.0	102.3	101.0
Value t-1 at current prices	0	500	400	100	Value index	105.0	105.0	105.0

This value-price-volume analysis can lead to corrections on any of the estimated variables. In some cases, these data can be checked with quantity data. For example, sometimes volume data on the supply and use of energy products are available. Another example is agriculture where volume data is available due to European agriculture policy. Another early check that is possible in the simultaneous approach is the ratio of the volume of value added and the input of labour.

Before entering the next step of the compilation process it is important to have a clear view on the reliability of the data for example on value added by industry or on the subtotals of intermediate consumption by industry.

Balancing with the emphasis on the product groups (second step in the column-row-columns scheme)

The result of the transformation process that was described in the previous paragraph is a data set that must be balanced in a supply and use framework. Just as in the preceding phase of the statistical process, the balancing takes place simultaneously for data at current prices, data at constant prices, volume indices and price indices.

Adjusting elements in either the use table or the supply table eliminates differences between the estimates of the supply and the use of a product group. If a figure at current prices is adjusted, the consequences for the corresponding figures in prices of the previous year, the volume index, as well as the price index are examined. If a figure at constant prices must be adjusted and as a result the volume index changes, then one has to decide whether or not to adjust the price index. In other words, the question must be answered whether or not to adjust the value at current prices. In this way the plausibility of an intended correction is checked as to several consequences.

Price indices that are found in the various columns of the supply and use table for one product group are a good starting point for the analysis of the discrepancies between supply and use. These indices were determined independently for each industry in the previous phases of the statistical process using available sources. One expects price differences over the row to be of limited size. Now they are compared and their consistency is checked.

The checks can point out where corrections should be made. Some corrections will result in corrections to output or intermediate consumption of an industry and thus to value added. Others will affect final expenditure. Resulting volume changes can be checked simultaneously for plausibility.

Below, a number of examples are given that illustrate the usefulness of a simultaneous balancing process. With each example one must keep in mind that it is important to form an opinion about the reliability of the data before starting to look for a solution. The first example in Box 9.3 illustrates a situation in which discrepancies are balanced at current as well as at constant prices.

Box 9.4: Example of a simultaneous balancing process: comparing volume-indices

Large discrepancies between volume changes of the main user of important raw materials and volume changes of the main supplier (for instance imports) are an indication for inconsistent data.

	Supply minus use	Domestic production	Imports	Main user	Other uses		Domestic production	Imports	Main user	Other uses
Value t at curent prices	0	50	468	426	92	Price index	100.0	104.0	100.0	100.0
Value t at constant prices of t-1	-18	50	450	426	92	Volume index	100.0	100.0	103.9	102.2
Value t-1 at current prices	0	50	450	410	90	Value index	100.0	104.0	103.9	102.2

In this example no discrepancy between supply and use at current prices is assumed. The value indices of imports and main user are both plausible: 104.0 and 103.9 respectively. However, analysis reveals that volume indices of imports and the main user differ: 100.0 versus 103.9 which is not plausible. Further analysis is necessary to find the solution for this balancing problem. It is not inconceivable that the value at current prices also has to be adjusted.

The second example in Box 9.4 shows that comparing volume indices of the main supplier and the main user indicates a solution for a balancing problem.

When the balancing phase has been completed, the user of the national accounts has at his/her disposal a system of tables containing consistent and detailed data on values, volume changes and price changes of goods and services. In addition, this system includes detailed information on levels and trends in primary incomes and final demand in both nominal and volume terms.

Balancing with the emphasis on the industries and final demand categories (third step in the column-row-column scheme)

At the end of the second step, supply and use is balanced for each product group. Corrections may have affected value added of industries and therefore GDP. So, a third step is necessary to check the results for plausibility.

There maybe two main reasons why corrections of value added or of final expenditure are not acceptable. Firstly, statistical sources indicate that the intended corrections are unacceptable. In that case the balancing process has to be reopened. Secondly, analysis of volume indices of production, intermediate consumption and value added by industry show large discrepancies. This is also a reason to reopen the balancing process. In both cases a reallocation takes place between intermediate consumption and/or between production and final consumption.

9.4.3 Sequential compilation of current and constant prices

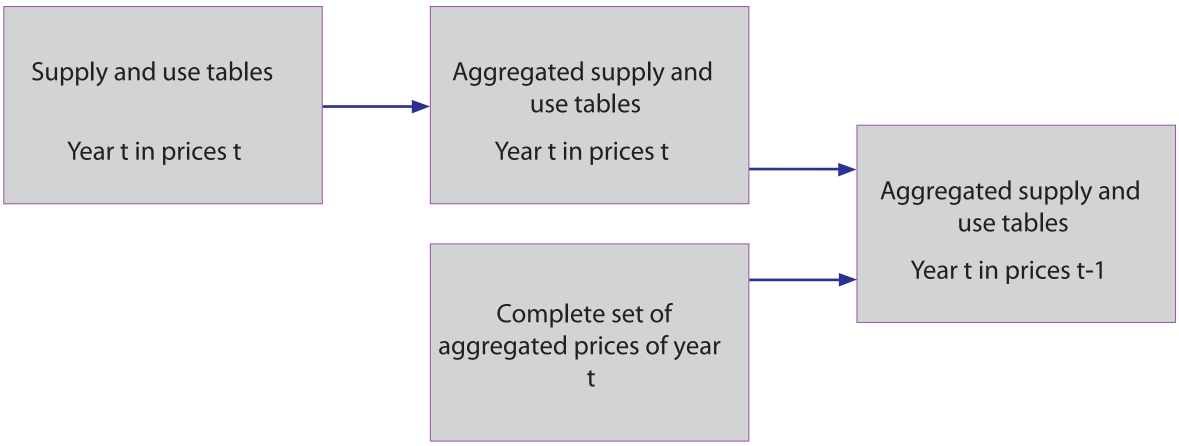
The starting point of a sequential compilation method is a balanced system of supply and use tables at current prices. As is the case with a simultaneous compilation method, a necessary requirement is the availability of a complete set of prices. If prices are only available at an aggregated level, one may decide to compile the tables at that aggregation level. If the price set is sufficiently detailed it is preferable to choose the same level of detail as the tables at current prices. In most cases, producers' prices, import and export prices, and consumers' prices by product group are available. The lack of price information about margins and taxes makes it necessary to make specific assumptions. In most cases, assumptions also have to be made to estimate prices of the remaining transactions (intermediate consumption, fixed capital formation, etc.). For instance, prices for fixed capital formation might be estimated as a weighted average of the prices of domestic production and imports of capital goods.

As in paragraph 9.4.2, the whole process can be described in a column-row-column scheme.

Deflating the current price tables (first step in the column-row-column scheme)

The first step is to deflate the current price values and to compile supply and use tables in prices of the preceding year, which is illustrated in Figure 9.3.

Figure 9.3: Sequential balancing at constant prices



As in paragraph 9.4.2, attention must be focused on the value added by industry group at constant prices. Analysis of the plausibility of the volume indices of production, intermediate consumption and value added can give reason to adjust the price set and, for instance, change the price index of intermediate consumption.

Balancing with the emphasis on the product groups (second step in the column-row-column scheme)

In this step, the discrepancies between supply and use by product group have to be eliminated. In practice, the adjustments are to be expected in those parts of the tables where price data is less reliable: intermediate consumption, fixed capital formation and changes in stocks. However, in some cases the best solution requires an adjustment of current price data. If it is not possible to reopen the tables at current prices, a second best solution must be applied, which could result in improbable price or volume indices.

Balancing with the emphasis on the industries and final demand categories (third step in the column-row-column scheme)

At the end of the second step, supply and use is balanced for each product group. Corrections may have affected value added of industries and therefore GDP. So, a third step is necessary to check the results for plausibility.

Analysis of volume indices of production, intermediate consumption and value added by industry is an important instrument to check for implausibilities. Discrepancies between the indices may give reason to reopen the balancing process.

9.5 A numerical example of more extended simultaneous balancing

9.5.1 Introduction

In this paragraph, a numerical example of simultaneous balancing is discussed. Balancing supply and use tables is very complicated because supply and use tables are valued differently. Supply is valued at basic prices and use is valued at purchasers' prices. In the basic supply and use scheme, the valuation of supply and use is equalised by adding columns for trade and transport margins, taxes and subsidies to the supply table. When balancing the supply/use scheme, three considerations are important:

1. Values at current prices and values at constant prices should preferably be balanced simultaneously
2. The transactions to be balanced should be related as closely as possible to the statistical sources they originate from. This advances the optimal allocation of balancing adjustments, since in case of inconsistencies errors caused by adaptations of source data can be excluded. This means that the data at the supply side should be available at basic prices and at the use side at purchaser's prices. For estimating constant price data, producer price indices should be applied on the supply side and purchasers' price indices on the use side (for example: CPI).
3. To ensure appropriate application of price indices, the valuation of transactions should be equal. Since the value at purchasers' prices can differ considerably by use category, value at basic prices seems to be the best valuation base.

Requirements 2 and 3 that are at first sight conflicting complicate the construction of an optimal balancing scheme. However, such a scheme is possible. In this section an example is presented which refers to the balancing of one product (Tables 9.7). The exact construction of the balancing scheme (e.g. grouping and detail of the transactions) depends on the available data. Essential features are the availability of values at current prices and at constant prices and the availability of values at basic prices next to values at purchasers' prices in the use table.

9.5.2 First estimates of supply and use

The second part of Table 9.7 (Supply) gives the first estimates of supply by domestic industries and imports. The first part of Table 9.7 (Use) gives the use by category. For the sake of simplicity some categories are assumed to be zero. Also, in the first part of Table 9.7, the discrepancy between supply and use is given in the last row. Finally, in the third part of Table 9.7, a recapitulation of supply and use valued at purchasers' prices is given. If data are directly available from statistical sources they have been placed in the scheme on the right spot. If data are not available, they are derived by applying commonly used assumptions. Data from statistical sources are printed in bold letters.

Supply

Domestic supply

- For t and t-1 the output by industry (*valued at basic prices*) is available at current prices.
- For t-1 to t a producer price index (101.0) is available.
- Values at constant prices and volume indices are derived from data at current prices and the price index.

Imports

- For t and t-1 the value of imports (*CIF-value*) at current prices is available.
- For t-1 to t an import price index (101.5) is available.
- The value at constant prices and the volume index are derived from data at current prices and the price index.

Use

Intermediate consumption by industries

- For t and t-1 the intermediate consumption by industry at current prices (*valued at purchasers' prices*) is available.
- These data are aggregated across industries into total intermediate consumption at current prices (*valued at purchasers' prices*).
- First estimates of trade and transport margins and taxes on products/subsidies on intermediate consumption are available.
- Intermediate consumption at current prices (*valued at basic prices)* is derived by subtraction.
- It is assumed that no price index of intermediate consumption is available. As a proxy, the price index of domestic supply is used (101.0).
- Total intermediate consumption (*valued at basic prices)* is deflated by the proxy price index.
- The value at constant prices and the volume index of intermediate consumption (*valued at basic prices*) is derived.
- As a first estimate, it is assumed that margins, taxes/subsidies and intermediate consumption (*valued at purchasers' prices*) have the same growth rate (volume index) as intermediate consumption (*valued at basic prices).*
- Values at constant prices and implicit price indices of margins, taxes/subsidies and intermediate consumption (*valued at purchasers' prices*) are derived.

Exports

- For t and t-1 exports at current prices (*FOB-value*) are available.
- First estimates of trade and transport margins and taxes on products/subsidies at exports are available.
- Exports at current prices (*valued at basic prices*) are derived by subtraction.
- For t-1 to t an export price index is available for export (*valued at basic prices)* (100.2).
- Exports (*valued at basic prices)* are deflated.
- The value at constant prices and the volume index of exports (*valued at basic prices*) are derived.
- Before balancing it is assumed that margins, taxes/subsidies and exports (*fob-value)* have the same growth rate (volume index) as exports *(valued at basic prices*).
- Values at constant prices and implicit price indices of margins, taxes/subsidies and exports (*fob-value*) are derived.

Private consumption of households

- For t and t-1 consumption by households at current prices (*valued at purchasers' prices*) is available.
- First estimates of trade and transport margins and taxes on products/subsidies at consumption of households are available.
- Private consumption at current prices (*valued at basic prices*) is derived by subtraction.
- For t-1 to t a price index is available for private consumption (*valued at purchasers' prices)* (101.9).

- Consumption (*valued at purchasers' prices)* is deflated.
- The value at constant prices and the volume index of consumption (*valued at purchasers' prices)* are derived.
- For a first estimate, it is assumed that margins and taxes/subsidies and consumption (*valued at basic prices)* have the same growth rate (volume index) as consumption *(valued at purchasers' prices)*.
- Values at constant prices and implicit price indices of margins, taxes/subsidies and consumption (*valued at basic prices*) are derived.

9.5.3 Considerations when balancing the product

The confrontation of the first estimates of supply and use in the example results in a discrepancy of –57 at constant prices and +81 at current prices. Solutions for eliminating the discrepancies are discussed below.

During the balancing process the aim is to find the best solution given time constraints, available resources and manpower. In principle every first estimate can be considered for adjustment. However, in practice the statisticians involved will know which estimates are most reliable. When balancing they will take into account the reliability of the data as well as the plausibility of the assumptions that have been made. Adjustments can be carried out on supply and on use of a product, trade and transport margins, and also on value, volume or price indices.

The balancing scheme presented here facilitates the search for acceptable solutions for balancing problems. All estimates are directly available in the scheme and the results of assumptions made for estimating growth rates, deflators, etc. of transactions are directly observable.

When analysing the causes of discrepancies, different approaches can be used. An example is the comparison of price indices. With a rather homogeneous product sold on a competitive market, comparable deflators are expected for supply and use and for separate use categories valued at basic prices.

One also expects comparable volume indices for a transaction valued at purchasers' prices and valued at basic prices. If there is a considerable difference, it shows that the share of distribution activities for this product must have changed. Another example is the comparison of the volume index of the main use categories with the volume index of supply. Different volume indices mean that there is a shift between categories.

9.5.4 A possible solution of the balancing problems in the numerical example

Which solution of the balancing problem is acceptable depends on the opinion of the statistical experts concerned as to the reliability of the first estimates. From this point of view, the solution presented below is only one of several possible solutions. This is discussed in Table 9.7.

Discussion of adjustments of the supply

At first sight there seems to be no reason to adjust the supply data. The difference between the price indices of domestic supply and imports are acceptable (101.0 and 101.5, respectively). Furthermore, data on supply often originate from reliable basic statistics. Drastic adjustment would, therefore, overrule reliable data, so other possible adjustments should be considered first.

Discussion of adjustments of the use

Intermediate consumption by industries

The estimated change of the intermediate consumption is comparable with the change in supply. This holds for values at current as well as at constant prices. Furthermore, the price indices of value at basic prices and value at purchasers' prices do not considerably differ. So, there seems to be no reason for drastic adjustments.

Table 9.7: Balancing scheme for a product: first estimates

	t-1 in current prices	Volume index	t-1 in prices of t-1	Price index	t in current prices	Value index
Use	**Balancing scheme for a commodity: first estimates**					
Intermediate consumption by industries						
Industry 1	**50**	100.8	50	101.2	**51**	102.0
Industry 2	**1000**	103.9	1039	101.2	**1051**	105.1
Industry 3	**100**	102.8	103	101.2	**104**	104.0
Total intermediate consumption value at purchasers' prices	1150	103.7	1192	101.2	1206	104.9
Retail trade margins	0	0	0	0	0	0
Wholesale trade margins	**130**	103.7	135	102.4	**138**	106.2
Transport margins	**50**	103.7	52	102.2	**53**	106.0
Taxes on products	**35**	103.7	36	99.2	**36**	102.9
Subsidies on products	**0**	0	0	0	**0**	0
Total intermediate consumption value at basic prices	935	103.7	969	**101.0**	979	104.7
Exports fob-value	**5150**	105.9	5452	100.4	**5471**	106.2
Retail trade margins	**0**	0	0	0	**0**	0
Wholesale trade margins	**500**	105.9	529	101.5	**537**	107.4
Transport margins	**200**	105.9	212	101.1	**214**	107.0
Taxes on products	**0**	0	0	0	**0**	0
Subsidies on products	**-50**	105.9	-53	100.1	**-53**	106.0
Exports value at basic prices	4500	105.9	4763	**100.2**	4773	106.1
Private consumption of households purchasres' prces	**16700**	102.9	17192	**101.9**	**17519**	104.9
Retail trade margins	**7500**	102.9	7721	104.1	**8037**	107.2
Wholesale trade margins	**1500**	102.9	1544	101.5	**1568**	104.5
Transport margin	**500**	102.9	515	101.0	**520**	104.0
Taxes on products	**400**	102.9	412	99.6	**410**	102.5
Subsidies on products	**-300**	102.9	-309	99.7	**-308**	102.7
Private cons. of households basic value	7100	102.9	7309	99.8	7292	102.7
Government consumption	PM					
Consumption PNP's	PM					
Gross fixed capital formation purch. Value	PM					
Changes of inventories	PM					
Total use value at basic prices	12535	104.0	13042	100.0	13044	104.1
Supply - use value at basic prices	0		-57		81	
Supply	**Balancing scheme for a commodity: first estimates**					
Domestic supply value at basic prices						
Industry 1	**9200**	104.0	9569	**101.0**	**9665**	105.1
Industry 2	**1235**	104.2	1287	**101.0**	**1300**	105.3
Industry 3	**100**	108.9	109	**101.0**	**110**	110.0
Total domestic supply value at basic prices	10535	104.1	10965	101.0	11075	105.1
Imports	**2000**	101.0	2020	**101.5**	**2050**	102.5
Total supply	12535	103.6	12985	101.1	13125	104.7

Recapitulation	Balancing scheme					
Supply value at basic prices	12535	103.6	12985	101.1	13125	104.7
Retail margins	7500	102.9	7721	104.1	8037	107.2
Wholesale margins	2130	103.7	2208	101.6	2243	105.3
Transport margins	750	103.8	778	101.1	787	104.9
Taxes/subsidies	85	101.5	86	98.5	85	100.0
Supply value at purchasers' prices	23000	103.4	23779	102.1	24277	105.6
Use value at purchasers' prices	23000	103.6	23836	101.5	24196	105.2
Supply-use value at purchasers' prices	0		-57		81	

Exports

Exports show much higher growth than domestic supply (5.9 and 4.1%, respectively). This could be a reason to reconsider this estimate. In addition, the price index is 1% lower than the price index of supply. The combination of these facts could be a reason to lower the estimate at constant prices.

Private consumption of households

The possibilities of solving a balancing problem by adjustment of private consumption are, on the one hand, often more promising than with other use categories. On the other hand, however, the analysis is also more complex. The reason is that private consumption valued at purchasers' prices consists of different components, each with a considerable value: retail trade margins, wholesale trade margins, transport margins and value at basic prices. This means that discrepancies can be solved by adjustments at different places. All intended adjustments have to be considered carefully to arrive at the best solution.

For instance, in case of a necessary adjustment of private consumption valued at basic prices, this can be realised by an adjustment of consumption at purchasers' prices or by an adjustment of e.g. the retail trade margin.

Looking at private consumption estimates in the example, the following points require special attention:

- The discrepancy at current prices can be solved by a correction on private consumption (*valued at basic prices)*. The rather low value index (102.7) seems to give room for such a correction. This can be carried out in three ways: by adjusting the value at purchasers' prices upward, reducing the trade margins or a combination of both. One aspect that makes a considerable correction on retail margins acceptable is the large value index of retail margins compared to both value at purchasers' prices and value at basic prices. Of course, it is necessary to assess the consequences of such corrections for price and volume indices. The price index of retail margins is by far the highest of all. So, lowering of the retail margin together with an adjustment of the price index is an interesting option.
- The price index of private consumption (*valued at basic prices*) differs considerably from the price index of supply (99.8 and 101.1, respectively). In addition, there is a large difference between the price index of private consumption valued at purchasers' prices (e.g. a CPI) and the price index of private consumption valued at basic prices, which has been calculated as a residual, (101.9 and 99.8,respectively). This difference can be carried back to the difference between on the one hand the CPI and on the other hand the (relatively high) price indices of the trade and transport margins. Especially the price indices of retail trade and wholesale trade are high. The conclusion is that adjustments of one or more price indices should be seriously considered. As a result, volume indices will also change. Reducing the price indices of margins means adjusting the price index of consumption (value at basic prices) upward and reducing the corresponding volume index. As a result, the discrepancy at constant prices will be reduced.
- When making the first estimates it has been assumed that the volume index of consumption (*valued at basic prices*), margins and taxes are equal to the volume index of consumption (*valued at purchasers' prices*). For taxes and subsidies this is the only correct assumption (changes of tax rates is a *price effect*). For trade and transport margins it is conceivable that volume indices can deviate from the volume index of the product flow. In that case it must be shown that the share and the quality of the distribution activities by trade have changed. In the example an increase of the volume index of retail trade margins and, perhaps, wholesale trade margins could be considered. Indications for such adjustments are the high price indices.

Which adjustments will be made in practice depends on the opinion of the statistical experts on the reliability of the first estimates. In this example we suppose that the following adjustments can be justified.

- A decrease of retail margins at current prices without an adjustment of values at constant prices.
- An increase of the volume index of retail trade margins to 103.5.
- The volume index of private consumption (valued at basic prices) plus wholesale trade margin plus taxes/subsidies is calculated (102.5).
- The remaining discrepancy at constant prices is eliminated by an adjustment of the price and volume indices of exports +05% respective -0.5%).

The results are presented in Tables 9.8.

Table 9.8: Balancing scheme for a product: after balancing

	t-1 in current prices	Volume index	t-1 in prices of t-1	Price index	t in current prices	Value index
Use	**Balancing scheme for a commodity: after balancing**					
Intermediate consumption by industries						
Industry 1	**50**	100.8	50	101.2	**51**	102.0
Industry 2	**1000**	103.9	1039	101.2	**1051**	105.1
Industry 3	**100**	102.8	103	101.2	**104**	104.0
Total intermediate consumption value at purchasers' prices	1150	103.7	1192	101.2	1206	104.9
Retail trade margins	0	0	0	0	0	0
Wholesale trade margins	**130**	103.7	135	102.4	**138**	106.2
Transport margins	**50**	103.7	52	102.2	**53**	106.0
Taxes on products	**35**	103.7	36	99.2	**36**	102.9
Subsidies on products	**0**		0		**0**	
Total intermediate consumption value at basic prices	935	103.7	969	**101.0**	979	104.7
Exports fob-value	**5150**	105.3	5422	100.9	**5471**	106.2
Retail trade margins	**0**	0	0	0	**0**	0
Wholesale trade margins	**500**	105.3	526	102.0	**537**	107.4
Transport margins	**200**	105.3	211	101.6	**214**	107.0
Taxes on products	**0**		0		**0**	
Subsidies on products	**-50**	105.3	-53	100.7	**-53**	106.0
Exports value at basic prices	4500	105.3	4738	**100.7**	4773	106.1
Private cons. of households purch. Value	**16700**	102.9	17192	**101.9**	**17519**	104.9
Retail trade margins	**7500**	103.5	7763	**102.5**	**7956**	106.1
Wholesale trade margins	**1500**	102.5	1538	102.0	**1568**	104.5
Transport margin	**500**	102.5	513	101.5	**520**	104.0
Taxes on products	**400**	102.5	410	100.0	**410**	102.5
Subsidies on products	**-300**	102.5	-308	100.2	**-308**	102.7
Private cons. of households basic value	7100	102.5	7277	101.3	7373	103.8
Government consumption	PM					
Consumption PNP's	PM					
Gross fixed capital formation purch. Value	PM					
Changes of inventories	PM					
Total use value at basic prices	12535	103.6	12985	101.1	13125	104.7
Supply - use value at basic prices	0		0		0	

Supply	Balancing scheme for a commodity: after balancing					
Domestic supply value at basic prices						
Industry 1	**9200**	104.0	9569	**101.0**	**9665**	105.1
Industry 2	**1235**	104.2	1287	**101.0**	**1300**	105.3
Industry 3	**100**	108.9	109	**101.0**	**110**	110.0
Total domestic supply value at basic prices	10535	104.1	10965	101.0	11075	105.1
Imports	**2000**	101.0	2020	**101.5**	**2050**	102.5
Total supply	12535	103.6	12985	101.1	13125	104.7
Recapitulation	**Balancing scheme**					
Supply value at basic prices	12535	103.6	12985	101.1	13125	104.7
Retail margins	7500	103.5	7763	102.5	7956	106.1
Wholesale margins	2130	103.2	2199	102.0	2243	105.3
Transport margins	750	103.3	775	101.6	787	104.9
Taxes/subsidies	85	101.3	86	98.7	85	100.0
Supply value at purchasers' prices	23000	103.5	23807	101.6	24196	105.2
Use value at purchasers' prices	23000	103.5	23807	101.6	24196	105.2
Supply-use value at purchasers' prices	0		0		0	

9.6 Deflation of supply of goods and services

In this paragraph a number of deflation methods are discussed. The discussion is not meant to be exhaustive. For a more extensive discussion, the reader is referred to the "Handbook on Price and Volume Measures in National Accounts" published by Eurostat.

9.6.1 Domestic production

Market production

Deflation by producers' price indices

Producers' price indices (PPIs) usually fulfil the formulated general requirements and are good indicators for the deflation of output of goods and services. A problem at the moment is that PPIs often only cover certain parts of the service sector.

In principle, PPIs account for changes in quality. Disadvantages are that most PPIs are Laspeyres type indices and that they use fixed weighting schemes, generally updated only once every five years. This argues in favour of applying PPIs at the lowest possible level of detail when deflating the domestic supply of commodities.

Deflation by unit value indices

Unit value indices of a product can be derived when for both the current year as well as the base year value and quantity information is available for domestic supply (e.g. from production surveys). Dividing the values by the corresponding quantities gives so-called unit values. If a PPI is not available, under certain circumstances a unit-value-index can be applied as a price index. However, a problem with unit value indices when used for deflation purposes is that they often refer to heterogeneous product groups. Therefore, their usefulness, generally spoken, is limited to the case where they refer to homogeneous mass products of which the quality does not change rapidly over time.

Deflation by tariff indices

Certain kinds of services (e.g. commercial business services, services of general medical practitioners) are paid for by tariffs, for example, a fee per time unit. Two problems have to be considered here. Changes in the quality of the services rendered as well as changes in the productivity per time unit are not accounted for in this approach. So, tariff-based price indices are only appropriate deflators if adjustments can be made for changes of quality and productivity or when it is known for sure that such changes are within acceptable limits.

If the service rendered does not change too much over time, indices derived from fee information can be used as approximate deflators for the supply of such services. Special attention has to be paid to the requirement of a high degree of representation of the observed tariff data for the whole of domestic supply.

Deflation by consumers' price indices (CPIs)

In some cases where PPIs are not available, CPIs can be used as approximate deflators for domestic supply of commodities. Two impediments have to be reviewed. Firstly, only if private households use a considerable part of the supply of a product, are CPIs appropriate deflators for the supply of a product. Secondly, only if trade and transport margins and taxes play a modest part in the value at purchasers' prices, is a CPI an appropriate deflator for the supply of a product. Special attention has to be given to changes in tax rates, e.g. VAT.

As a result CPIs especially are candidate deflators for services mainly rendered to private households.

An advantage is that CPIs account for changes in quality. Disadvantages are that most CPIs are Laspeyres type and that they use fixed weighting schemes, generally up-dated only once every five years. This argues in favour of applying CPIs at the lowest level of detail as possible when deflating the domestic supply of commodities.

Deflation by the model pricing approach

The model pricing approach asks producers to provide price estimates for typical real, or even hypothetical, products. Model price indices can be candidate approximate deflators when there are significant changes in product specification from one year to the next and especially in areas where products are unique. An important advantage is that since the same product or project is priced, the quality is unchanged. However, disadvantages are that, especially in areas of rapid product change, the degree of representation of the observed price change for total supply is questionable.

Deflation by hedonic price indices

Hedonic price indices are candidate deflators when product specification and quality change significantly. The method is based on an assessment of certain measurable characteristics that make up such a product. For example, in personal computers, memory and processing speed are two such characteristics. The main advantage is that quality changes are explicitly captured so that productivity changes are taken into account. A serious drawback is the complexity of the method. Furthermore, the resulting quality adjustment factor seems to be highly dependent on the choice of the characteristics and the choice of the regression model.

Extrapolation by quantity indicators

It was mentioned that the use of quantity indicators for splitting up value changes into volume and price changes is usually more expensive than deflation by price indices. However, it appears that for some commodities where price observation is difficult or not yet carried out, a considerable amount of quantity data are collected for other purposes. Examples can be found in the medical sector (e.g. number of inpatients of short-stay hospitals classified by diagnoses related groups), the cultural sector (e.g. number of visitors of theatrical performances) and the banking sector (e.g. number of saving accounts, number of credits granted to commercial and private customers, number of payments on bank accounts). Since the data have already been collected, the high cost impediment does not hold here. Of course, quantity indicators have to fulfil the general requirements. If they do, quantity indicators are appropriate indicators, especially in the case of specific services where price indicators are not available. Of course, quantity indicators have also to fulfil the requirement of accounting for quality change of the service.

Input-methods

Input methods use the weighted price or volume changes of intermediate and primary inputs as a proxy for the price or volume change of the output of an industry. The advantage of input methods is that in case of deflation within a supply and use framework the necessary data are readily available, as all inputs have already been deflated. However, a considerable disadvantage is that the price and volume indicators are not directly related to output. As a result, the change of value added at constant prices and also productivity changes of an industry cannot be calculated in a proper way. For that reason, input methods have to be avoided as much as possible. Another disadvantage is that input methods can only be applied for the total production of an industry. A separate deflation of the different products of an industry is impossible. According to Commission Decision 98/715 the use of input methods for the deflation of market production will no longer be allowed in the future.

Non-market production

Non-market production can be classified into services consumed on an individual basis, and collective services. In the former case, quantity indicators can be found, e.g. by counting and classifying the customers of a service. In the latter case the search for appropriate quantity indicators is much more laborious.

Non-market production consumed on an individual basis

For non-market production there is also a volume and a price component in the change of value. However, in this case price changes are non-existent. So the only way left is direct observation of quantity information. Generally speaking, just as with market production, the collection of sufficiently reliable quantity data would be expensive. However, especially for some non-market services consumed on an individual basis a high amount of quantity data is available, which has already been collected for other purposes. Examples can be found in the areas of public transport, medical services, culture and educational services. Of course, such data have to meet the national accounts requirements for volume indicators. One requirement is that they have a direct relation to the activity at hand. Another requirement is that they account sufficiently for changes in quality.

Collective services

Collective services are not rendered to separate customers but to groups of citizens or to the society as a whole. Because of their collective character, it is very difficult, if not impossible, to find direct price or volume indicators for collective services. Given this, it would be alluring to apply any quantity information that is available. However, it must be emphasised that the indicators have to be related to the true output of the activity and not to an input or an intermediary activity.

Because of the absence of appropriate indicators, the last resort for the deflation of collective services seems to be the use of a kind of input method. As mentioned above, a serious drawback of this approach is that productivity changes cannot be measured in an independent way.

9.6.2 Imports of goods and services

Deflation by imports price indices

Import price indices usually fulfil the general requirements and are good indicators for the deflation of imported goods. A problem at the moment is that import price data are generally not available for services.

In principle, import price indices account for changes in quality. Disadvantages are that they mostly are Laspeyres type and that they use fixed weighting schemes, generally up-dated only once every five years. This argues in favour of applying them at the lowest level of detail as possible.

Deflation by unit value indices

Foreign Trade Statistics often provide the value of imports as well as the corresponding quantities at a detailed level. From this information unit value indices can be derived. A problem with unit value indices when used for deflation purposes is that they often refer to heterogeneous product groups. Sometimes the unit of measurement is kg; often the unit is simply the number of items. This implies that in many cases, unit value indices suffer from heterogeneity. Therefore, the possibilities for their use as deflators, generally speaking, are limited. However, if no appropriate information from price statistics is available and the unit values refers to homogeneous mass products of which the quality does not change rapidly with time, they can be applied as useful proxy deflators.

Other proxies

At the moment deflation by imports price data and by unit value indices is only possible for imported goods. Direct deflators for services are not available. Two impediments have to be mentioned here. The first is the more general problem of the exact observation of the imports by product group according to the classification in the supply and use tables. The second, and for deflation most important, problem is that the price observation of imported (and exported) services is an underdeveloped area in nearly all countries. This is the reason why in the national accounts for the deflation of the imported services we have to resort to proxies based on rough assumptions.

An obvious assumption would be that for every product the price generating conditions at the domestic market tend to bring about one price, which holds for both domestic supply and imported services. As far as this assumption is true, the price index of the domestic supply of a service is a good proxy for the price index of the imports of that service. The validity of the assumption depends on if imports are a large part of the domestic market, and/or if imported goods are of same quality to home goods.

9.7 Deflation of trade and transport margins

9.7.1 Deflation of trade margins

Trade margins play a special role in supply and use tables as a bridge between the valuation of the supply and the valuation of the use of goods. They are the remuneration for the services rendered by the trade industry to producers and consumers in the distribution of goods. As with other services the appropriate deflation of trade services requires price or volume indicators directly related to the service rendered. At present, methods to observe or derive price and volume indices based on direct price and quantity indicators are not readily available. A main reason is that complex and difficult conceptual problems still have to be solved. Most of them are related to the measurement of the quality of the services. So, for the time being approximate methods must be applied.

The size of trade margins is relatively large and the trade industry generates a considerable part of GDP. For that reason it is important to develop methods for the direct observation of price and volume changes of trade in the near future. Firstly, some aspects of such a direct approach are discussed. Thereafter, the method suggested in ESA is discussed.

Direct deflation of the output of the trade industry

It is difficult to define the services rendered by the trade industry precisely. In economic literature no unambiguous picture is presented. Numerous aspects are mentioned which all influence the quality of the services of the trade industry: e.g. amount of information given to the customers, after sales services, delivery time, assortment, quality of shop assistants and availability of parking lots. The multiplicity of the relevant aspects make it very difficult to collect the right data for direct deflation of trade services (including changes in quality) and, if they are available, to weight the quality aspects together.

A possible approach to keep track of quality changes and at the same time circumventing the direct observation of quality aspects, is to deflate purchases for resale and the corresponding sales of the trade industry separately, applying appropriate price indices and subsequently calculate trade margins at constant prices as the difference. However, this approach requires high quality price indices for both purchases and sales of products by the trade industry. Perhaps prospects are best for retail trade when PPIs and CPIs are often available at a detailed product level. Unfortunately, for wholesale trade prospects are worse.

Approximation by the volume-index of the commodity flow

A proxy for the estimation of the volume index of the trade margin on a product is based on the assumption that the volume change in trade margins equals the volume change of the commodity flow. An alternative way to formulate this is to say that the percentage of trade margins at constant prices equals the percentage of the current prices of t-1. Trade margin percentages are here defined as the ratio of margins and the relevant commodity flow valued at purchasers' prices. The proxy can be refined if the volume change in trade margins is usually related to the volume change in the turnover of trade.

There would be no difference if the degree to which trade is involved in the commodity flow does not change from one year to another. In that case the volume change in the turnover of trade is equal to the volume change of the commodity flow. However, the position in the market of wholesale trade can change, for instance, if producers decide to deliver directly to the buyer.

The position of the trader in the market can be reflected in the "involvement rate" which can be defined as the ratio between turnover of trade and the relevant commodity flow.

The relation of the flow and the turnover of trade can be written as:

$$VI_{trt} = F * VI_{flow}$$

where

VI_{trt} = volume index of turnover of trade
F = change in the involvement rate of traders in the total flow of a product group
VI_{flow} = volume index of the corresponding commodity flow

If F = 1 then the involvement rate of trade in the commodity flow has not been changed from t-1 to t and the volume index of the flow equals the volume index of the turnover of trade. In case $F \neq 1$ the assumption is not valid and it would be helpful to collect data on involvement rates by product.

Trade margins at constant prices can be written as:

$$TR_{t/t-1} = TR_{t-1/t-1} * VI_{trt}$$

where

$TR_{t/t-1}$ = trade margins of t in prices of t-1
$TR_{t-1/t-1}$ = trade margins of t-1 in prices of t-1

Improvement by taking into account shifts between types of outlet

The method described above provides better results when applied at a detailed product level as used in a supply and use table. A further improvement can be reached by a breakdown of trade margins on a product by type of outlet, assuming that different outlets provide different qualities of services. In this way quality changes due to turnover shifts between outlets is accounted for.

The modified formula for the calculation of the volume index for trade margins is:

$$TR_{t/t-1} = \sum_i \sum_j \frac{TR\,(i,j)_{t-1/t-1} * VI\,(i,j)_{trt,i,i}}{TR\,(i,j)_{t-1/t-1}}$$

in which:

$TR(i,j)_{t-1/t-1}$ = trade margins for product i and outlet j of t-1 in prices of t-1
$VI(i,j)_{trt}$ = volume index for the turnover of trade of product i and outlet j

9.7.2 Deflation of transport margins

For the deflation of transport margins, price indices for the output of transport industries can be used. A necessary condition is the existence of a matrix of transport margins by type of transport (column) and product (row). By column, the price index of the relevant type of transport can be applied. Volume changes of the transport margins linked to volume changes of the transported commodities can be used to check the plausibility of the results. Generally one expects that these two volume changes are more or less the same.

Another approach is to firstly derive constant prices estimates, applying the volume changes of the transported commodities on the previous years' results and secondly inflate these with the appropriate price indices in order to arrive at current price estimates.

9.8 Deflation of taxes and subsidies on products

9.8.1 Introduction

Taxes and subsidies on production and imports are divided into:

- Taxes and subsidies on products
- Other taxes and subsidies on production.

Taxes (subsidies) on products are taxes (subsidies) that are payable per unit of some good or service produced or transacted. The tax (subsidy) may be a specific amount of money per unit of quantity of a good or service, or it may be calculated as a specified percentage of the price per unit or value of the goods and services transacted. Examples of taxes on products are value added tax, excises, duties on imports, etc.

For an accurate estimation of the volume index of a tax or a subsidy, it is very important to determine which part of the supply or use of a product is liable to this tax or subsidy. For instance, taxes are levied only on domestic consumption of a product and not on exports. Another example is subsidies on dairy products, which are only given on exports to countries outside the European Union. In other cases special subsidies are given only on production surpluses used as raw materials by the cattle-fodder manufacturing industry.

Other taxes (subsidies) on production consist of all taxes (subsidies) that units incur (receive) as a result of engagement in production, independently of the quantity or value of the goods and services produced or sold. Examples are road tax, taxes on ownership of dwellings, payroll subsidies etc.

9.8.2 Taxes and subsidies on products

Because for the deflation of supply and use tables Laspeyres volume indices and Paasche price indices are applied taxes and subsidies on products affect the *price* of a product and not the *volume*. This means that for deflation it is a requirement that the volume index of the value including tax (subsidy) of a product equals the volume index of the value excluding tax (subsidy). As a result also the volume index of the tax (subsidy) must equal the volume index of the product on which the tax (subsidy) is applied.

In this paragraph constant price estimation for taxes and subsidies on products is elaborated for taxes. For subsidies similar calculations can be made.

Suppose q(t-1) and q(t) are the quantities of a taxed product in t-1 and t;

bp(t-1) and bp(t) are the prices exclusive of tax (basic prices);

ta(t-1) and ta(t) are the taxes per quantity unit; and

pp(t-1) and pp(t) are the prices inclusive of tax (producers' prices).

Volume index

The volume index according to the Laspeyres formula of the *value excluding tax* is

$$\frac{\Sigma \; bp(t-1) * q(t)}{\Sigma \; bp(t-1) * q(t-1)} = \frac{\Sigma \; bp(t-1) * q(t-1) * \; [q(t) / q(t-1)]}{\Sigma \; bp(t-1) * q(t-1)}$$

The volume index according to the Laspeyres formula of the *value including tax* is

$$\frac{\Sigma\ pp(t\text{-}1) * q(t)}{\Sigma\ pp(t\text{-}1) * q(t\text{-}1)} = \frac{\Sigma\ pp(t\text{-}1) * q(t\text{-}1) * \ [q(t) / q(t\text{-}1)]}{\Sigma\ pp(t\text{-}1) * q(t\text{-}1)}$$

The volume index according to the Laspeyres formula of the *value of the tax* is

$$\frac{\Sigma\ [pp(t\text{-}1) - bp(t\text{-}1)] * q(t)}{\Sigma\ [pp(t\text{-}1) - bp(t\text{-}1)] * q(t\text{-}1)} = \frac{\Sigma\ ta(t\text{-}1) * q(t)}{\Sigma\ ta(t\text{-}1) * q(t\text{-}1)}$$

$$= \frac{\Sigma\ ta(t\text{-}1) * q(t\text{-}1) * \ [q(t) / q(t\text{-}1)]}{\Sigma\ ta(t\text{-}1) * q(t\text{-}1)}$$

and the value of the tax in t in prices of t-1 is $\Sigma\ ta(t\text{-}1) * q(t\text{-}1) * \ [q(t) / q(t\text{-}1)] = \Sigma\ ta(t\text{-}1) * q(t)$

Price index

The price index of the tax according to the Paasche formula is

$$\frac{\Sigma\ ta(t) * q(t)}{\Sigma\ ta(t\text{-}1) * q(t)} = \frac{\Sigma\ ta(t) * q(t)}{\Sigma\ ta(t) * q(t)\ / [ta(t) / ta(t\text{-}1)]}$$

Value index

The value index calculated from the volume and the price index is

$$\frac{\Sigma\ ta(t\text{-}1) * q(t)}{\Sigma\ ta(t\text{-}1) * q(t\text{-}1)} * \frac{\Sigma\ ta(t) * q(t)}{\Sigma\ ta(t\text{-}1) * q(t)} = \frac{\Sigma\ ta(t) * q(t)}{\Sigma\ ta(t\text{-}1) * q(t\text{-}1)}$$

There are two categories of taxes (subsidies) on products: taxes levied on quantity and taxes on value. In the next sections we will discuss them separately.

Taxes on products levied on quantity

Examples are *excises* on tobacco, alcoholic drinks and fuel by kind.

The volume index, according to the Laspeyres formula, of the *tax* is

$$= \frac{\Sigma\ ta(t\text{-}1) * q(t\text{-}1) * \ [q(t) / q(t\text{-}1)]}{\Sigma\ ta(t\text{-}1) * q(t\text{-}1)}$$

In case of taxes on quantities *ta(t-1)* is the tariff *tq(t-1)* of the tax in t-1. So, the volume index of the tax is

$$= \frac{\Sigma\ tq(t\text{-}1) * q(t\text{-}1) * \ [q(t) / q(t\text{-}1)]}{\Sigma\ tq(t\text{-}1) * q(t\text{-}1)}$$

and the value of the tax for t in prices of t-1 is $\Sigma\ tq(t\text{-}1) * q(t\text{-}1) * \ [q(t) / q(t\text{-}1)] = \Sigma\ tq(t\text{-}1) * q(t)$.

The price index of the tax value is

$$\frac{\Sigma \; tq(t) * q(t)}{\Sigma \; tq(t-1) * q(t)} = \frac{\Sigma \; tq(t) * q(t)}{\Sigma \; tq(t) * q(t) \; / \; [tq(t) / tq(t-1)]}$$

If tq(t) and tq(t-1) are the same for every transaction, this can be rewritten as

$$\frac{tq(t)}{tq(t-1)} * \frac{\Sigma \; tq(t) * q(t)}{\Sigma \; tq(t) * q(t)} = \frac{tq(t)}{tq(t-1)}$$

So, in that case the price index of a tax on quantity is the tariff index.

Taxes on products levied on value

An important example is value-added tax (VAT).

The volume index according to the Laspeyres formula of the *value of the tax* is

$$= \frac{\Sigma \; ta(t-1) * q(t-1) * \; [q(t) / q(t-1)]}{\Sigma \; ta(t-1) * q(t-1)}$$

In case of taxes on value *ta(t-1)* is the tariff *tv(t-1)* of the tax in t-1 multiplied by the price

p(t-1) (exclusive tax) of the product. So, the volume index is

$$= \frac{\Sigma \; tv(t-1) * p(t-1) * \; q(t-1) * \; [q(t) / q(t-1)]}{\Sigma \; tv(t-1) * p(t-1) * \; q(t-1)}$$

and the value of the tax for t in prices t-1 is $\Sigma \; tv(t-1) * p(t-1) * \; q(t)$

The price index is

$$\frac{\Sigma \; ta(t) * q(t)}{\Sigma \; ta(t-1) * q(t)} = \frac{\Sigma \; tv(t) * p(t) * \; q(t)}{\Sigma \; tv(t-1) * p(t-1) * \; q(t)}$$

$$= \frac{\Sigma \; tv(t) * p(t) * q(t)}{\Sigma \; tv(t) * p(t) * q(t) \; / \; \{[tv(t) / tv(t-1)] * [p(t) / p(t-1)]\}}$$

In the case of a tax on value, the price index of the tax is usually different for different transactions. The reason is that they depend on the price index of the value at basic prices of the transactions. Furthermore, different tariffs exist for different commodities.

Subsidies

The practical elaboration of constant price estimation of taxes on products presented above can be similarly applied to subsidies on products.

9.9 Deflation of use of goods and services

9.9.1 Intermediate consumption by industries

Deflation by intermediate consumption price indices

Intermediate consumption price indices (ICPIs) usually fulfil the general requirements and are good indicators for the deflation of intermediate consumption of goods. A problem is that ICPIs hardly ever cover intermediate consumption of services.

In principle, ICPIs account for changes in quality. Disadvantages are that most ICPIs are Laspeyres type and that they use fixed weighting schemes generally up-dated only once every five years. This argues in favour of applying ICPIs at the lowest possible level of detail when deflating the domestic supply of commodities.

Deflation by unit value indices

Unit values of a product can be derived when both value and quantity information is available (e.g. from production surveys) for (a part of) intermediate consumption. Using these, so-called unit value indices can be calculated. A problem with unit value indices when used for deflation purposes is that they often refer to heterogeneous product groups. Therefore, the possibilities for their use, generally spoken, are limited. However, if no appropriate ICPIs are available and they refer to homogeneous mass products of which the quality does not change rapidly with time, they can be applied as useful proxy deflators.

Box 9.5: Real versus theoretical tax revenue

In practice, for several reasons, the actual tax revenue (the tax receipts by the tax authorities) of a certain tax can differ from the theoretical tax revenue (tax calculated from the multiplication of tax tariffs and value at basic prices of transactions). Reasons could be non-collection by the tax authorities, measuring errors, etc. In national accounts it is an important question how to deal with differences between the theoretical tax value index and the index of the actual tax revenue: will it be added to the volume index or to the price index? This is a choice between two evils: to affect the volume index or the price index. Both are important in national accounts.

However, there are two considerations providing an answer to that question. The first is that in national accounts the estimation of volume growth rates is still somewhat more important than the estimation of price indices. So, the difference has to be added to the price index and the volume index will not be changed. Even more important is that non-collection in fact means lowering of the tax rate and therefore has to be seen as price. It is recommended, when deflating taxes on products, firstly to estimate the volume index (from the volume index of the value inclusive or exclusive tax) and the value of taxes in year t in prices of t-1 and then calculate the price index of the tax as a residual.

An additional problem is that usually the actual tax revenue is only available for the total of all transactions that have been levied with that tax. At the detailed transaction level only the theoretical tax revenue can be calculated. Differences between the value indices of the actual and the theoretical tax revenues are only manifest at the aggregate level.

An important question is whether to make corrections for differences between the actual and the theoretical revenue or not. If corrections have to be made, a decision has to be taken whether this happens only at the aggregated level (one special correction row in the use table) or also at the detailed level.

For the deflation of taxes it is important that corrections never affect the estimated volume indices at the detailed level. Since weights based on actual tax revenues differ from weights based on theoretical tax revenues it is unavoidable that volume indices at the aggregated level are more or less different.

Deflation by price indices of supply

In some cases where ICPIs are not available, price indices of supply can be used as approximate deflators for intermediate consumption of goods and services. Two impediments have to be reviewed. Firstly, price indices of supply are only appropriate deflators for intermediate consumption of a product in case intermediate consumption accounts for a considerable part of the turnover of a product. Secondly, price indices of supply are only appropriate deflators for the intermediate consumption of a product in case margins and taxes play a modest part in the composition of the purchaser's price. As a result price indices of supply are especially candidate deflators for intermediate consumption of services.

Box 9.6: Newly introduced and disappearing taxes and subsidies

As was stated above, when using Laspeyres volume indices and Paasche price indices, taxes and subsidies on products affect the price of a product and not the volume, implying that the volume index of the value including tax (subsidy) of a product equals the volume index of the value excluding tax (subsidy). As a result the latter also equals the volume index of the tax (subsidy) value. In case of newly introduced or disappearing taxes (subsidies), these conditions give rise to remarkable results. In the example, trade and transport margins are omitted. However, these results are in conformity with the registration of changes in taxes on products as a price change.

Example 1: Newly introduced taxes on products

Applying the guidelines that the volume change at producers prices equals the volume change at basic prices, implies that taxes on products at constant prices equal zero, while the current price amount is not zero:

	Year Current prices	Price index	Year t Constant prices	Volume index	Year t-1 Current prices
Output at basic orices	1000	100	1000	100	1000
Taxes on products	100	0	0	0	0
Output at purchasers' prices	1100	110	1000	100	1000

As one would expect, the introduction of a tax on products results in an increase of the purchasers' prices

Example 2: Disappearing taxes on products

Applying the guidelines that the volume change at producers' prices equals the volume change at basic prices, implies that taxes on products at constant prices are not zero, while at current prices the amount equals zero, since:

	Year Current prices	Price index	Year t Constant prices	Volume index	Year t-1 Current prices
Output at basic orices	1000	100	1000	100	1000
Taxes on products	0	0	100	100	100
Output at purchasers' prices	1000	91	1100	100	1100

As one would expect the disappearance of a tax on products results in a decrease of the purchasers' prices.

Deflation by consumers' price indices

In some cases where ICPIs are not available, CPIs can be used as proxy deflators for intermediate consumption of commodities. An important requirement is that market conditions for intermediate and private consumption are comparable. This means for example that the share of wholesale and retail margins in the purchaser's price is nearly the same. An example of goods where intermediate and private consumption often show comparable price changes is fuel for motorcars.

In a number of cases the error in the estimation of total GDP due to the use of less appropriate price indices will be limited. When intermediate consumption is the main part of turnover of a domestically produced product, underestimation of intermediate consumption and thus overestimation of value added in one industry will be counterbalanced by an underestimation of output (product, trade or transport margins) thus an underestimation of value added in another industry.

9.9.2 Exports of goods and services

Deflation by exports price indices

Exports price indices usually fulfil the requirements formulated in 2.2 and are good indicators for the deflation of exported goods. A problem at the moment is that export price statistics are often not available for services.

In principle, export price indices account for changes in quality. Disadvantages are that they mostly are Laspeyres type and that they use fixed weighting schemes generally up-dated only once every five years. This argues in favour of applying them at the lowest level of detail as possible.

Deflation by unit value indices

Foreign Trade Statistics often provide the value of exports as well as the corresponding quantities at a detailed level. From this information unit value indices can be derived. A problem with unit value indices when used for deflation purposes is that they often refer to heterogeneous product groups. The unit of measurement can be kilos or simply the number of products. That means that unit value indices in many cases suffer from heterogeneity. Therefore, generally spoken, the possibilities for their use as deflators are limited. However, if no appropriate information from producer's price statistics is available and the unit values refer to homogeneous mass products of which the quality does not change rapidly over time rapidly, they can be applied as useful proxies of deflators.

Deflation by price indices of supply

In some cases where price indices for exports are not available, price indices of supply can be used as approximate deflators. Two impediments have to be reviewed. Firstly, price indices of supply are only appropriate deflators for exports of a product in case exports accounts for a considerable part of the turnover of a product. Secondly, price indices of supply are only appropriate deflators for the exports of a product if margins and taxes play a modest part in the composition of the purchaser's price. As a result price indices of supply are especially candidate deflators for intermediate consumption of services.

Other proxies

At the moment, deflation by exports price data and by unit value indices is only possible for export of goods. Direct deflators for services are generally not available. Two impediments have to be mentioned here. The first is the more general problem of the exact observation of the exports by product group according to the classification in the supply and use tables. The second, and for deflation most important, problem is that the price observation of exported services is an underdeveloped area in nearly all countries. For that reason in the national accounts for the deflation of the exported services we have to resort to proxies based on rough assumptions.

A simple but rough assumption is that for every product the price index for exports equals the price index of domestic production. Another possibility would be to collect information on the price changes of that service in the customer countries (see imports of services).

9.9.3 Private consumption of households

Deflation by consumption price indices

Consumption price indices (CPIs) usually fulfil the general requirements. For instance, CPIs in principle take account of changes in quality. So, they are excellent indicators for the deflation of the private consumption of goods and services.

Most CPIs are Laspeyres type and they use fixed weighting schemes. This argues in favour of applying CPIs at the lowest possible level of detail.

Deflation by price indices of supply

In some cases where CPIs are not available, price indices of supply can be used as approximate deflators for private consumption of goods and services. Two impediments have to be reviewed. Firstly, price indices of supply are only appropriate deflators for private consumption of a product if private households use a considerable part of the supply of a product. Secondly, price indices of supply are only appropriate deflators for the private consumption of a product where margins and taxes play a modest part in the composition of the purchaser's price. As a result, price indices of supply are especially candidate deflators for private consumption of services.

9.9.4 Government consumption

Government consumption equals government production minus sale of market production by government. Constant price estimates can be derived likewise.

9.9.5 Gross fixed capital formation

Deflation by price indices of capital goods

Specific price indices for capital goods (FCPIs) usually fulfil the requirements formulated in 2.2 and are good indicators for the deflation of gross fixed capital formation in goods. A problem is that FCPIs are hardly ever part of the program of the statistical offices.

In principle, FCPIs account for changes in quality. Disadvantages are that FCPIs are often Laspeyres type and that they use fixed weighting schemes generally up-dated only once every five years. This argues in favour of applying FCPIs at the lowest level of detail as possible when deflating the domestic supply of commodities.

Deflation by price indices of supply

In some cases where FCPIs are not available, price indices of supply can be used as approximate deflators for gross fixed capital formation in goods and services. Two impediments have to be reviewed. Firstly, price indices of supply are only appropriate deflators for private consumption a product if private households use a considerable part of the supply of a product. Secondly, price indices of supply are only appropriate deflators for capital goods of a product if margins and taxes play a modest part in the composition of the purchaser's price. As a result price indices of supply are especially candidate deflators for capital goods of services.

9.9.6 Changes in inventories

The calculations of changes in inventories (CI) at current and constant prices are often closely interlinked. If good current price estimates can be made because good data exist, then it is often possible to make good constant price estimates as well, since the same data are used.

In practice, the data available for the calculation of changes in inventories do not allow a 'perfect' estimation. Assumptions and approximations have to be made. The estimation methodology for CI (both at current and constant prices) is highly dependent on the kind of information on inventories that is available. Perhaps a rather obvious observation, but still worthwhile taking into account, is that volume indices of CI are meaningless. Only price indices can be meaningfully calculated and only for homogeneous products.

In the ideal case, information is available on the exact times and quantities of additions to and withdrawals from the inventory and the price of the product at those times. Then it is in principle straightforward to calculate the CI at current and at constant prices. Additions and withdrawals have to be valued at the prices prevailing at the times at which they take place. The CI at constant prices is calculated by valuing the quantities of additions and withdrawals at the average prices of the previous year.

In many cases, enterprises will not be able to give data on quantities, but only on the value of the level of their inventories at the beginning and end of the year according to their own bookkeeping system. These bookkeeping systems generally do not value inventories according to ESA rules, but for example following a historic cost system, LIFO system, etc. Therefore, these values cannot be used directly in the national accounts. In this case, the change in volume has first to be derived, which can then be multiplied with an appropriate price index to arrive at CI at current prices. In order to calculate correctly the change in volume of inventories, information is needed on the bookkeeping system used in the enterprise.

For a more detailed discussion on constant price estimation of the changes in inventories, the reader is referred to the Handbook on price and volume measures in national accounts.

9.10 Value added by industry

9.10.1 Total value added

Double indicator methods

Total value added at current prices by industry is estimated as the difference between gross output and intermediate consumption of goods and services. For the estimates at constant prices the same method is applied. In consequence, the following condition holds:

Deflated total value added = Deflated gross output - Deflated intermediate consumption

The corresponding price and volume indices are derived afterwards. This method is called a double indicator method. Double indicator methods are, from a theoretical point of view, superior to the so-called single indicator methods, since they take into account changes of both output and input and derive value added as a residual, in conformity with its definition. Since with a double indicator method the volume index of value added is the result of independent estimates of the volume indices of gross output and intermediate consumption the results are pre-eminently appropriate for productivity analysis. There are three variants of the double indicator method.

Double deflation

In double deflation, current price estimates for output and of intermediate consumption are both deflated by appropriate price indices. Constant price value added is derived by subtraction.

Double extrapolation

In double extrapolation, previous year values of output and intermediate consumption are extrapolated using appropriate volume indices, and constant price value added is derived by subtraction.

Extrapolation and deflation

This is a combination of extrapolation of gross output of the previous year by a volume index and deflation of intermediate consumption of the current year by a price index. Constant price value added is calculated by the subtraction of deflated intermediate consumption from extrapolated gross output.

9.10.2 Compensation of employees

Compensation of employees is part of total value added. It is useful to estimate compensation of employees at constant prices, as it increases the possibilities for economic analysis based on supply and use tables. Among others, the results can be used in the analysis of labour productivity. Another application is price analysis: e.g. the price change of the output of an industry is explained from the price changes of the inputs including compensation of employees.

Compensation of employees consists of two parts, wages and salaries, both in cash and in kind, and employers' social contributions. The deflation of both parts should be closely connected since both relate to the same labour input. So, both volume indices have to be the same. As a consequence, it is not necessary to estimate price and volume indices for both parts. Since employers' social contributions are liable to complex legislation it is difficult to observe their price index. This means that in practice wages and salaries will be deflated and the resulting volume index will also be applied in calculation employers' social contributions at constant prices.

An important question concerns the appropriate unit of the volume of labour. Many candidate units suffer from heterogeneity. For instance, numbers of employed persons do not account for the number of hours worked per person. Even full-time equivalent jobs are not sufficiently homogeneous since they do not account for reductions in working hours and differences in education level, skill, etc. of the employees. Therefore, for the purpose of measuring the volume of the input of labour in an industry, the most appropriate quantity unit may be the number of hours worked classified into education levels, skill etc. The corresponding price is the value of this unit.

The correct definition of the number of hours worked needs special attention. Employees are usually paid for the number of contractual hours. However, these include holidays, absence through illness etc. It will be clear that the number of hours *actually* worked is the better volume indicator.

A special remark has to be made on the deflation of wages and salaries in kind. One could deflate wages in kind by the price index of the goods and services provided by the employer. For example, reimbursements for travel costs to and from work could be deflated with the price indices by type of transport. A second approach is to assume that the volume index of wages and salaries in kind equals the volume index of wages and salaries in cash. In this case a change of the amount of goods and services provided is seen as a price change. There are good arguments to prefer the second approach. As a change in the amount of wages in kind is a substitute for a change of the wage rate in cash it has to be completely regarded as a price change of labour, even if only the quantity of the provided goods and services changes. Further, the heart of the matter is the input of *labour* in the production process and not the input of provided goods and services or reimbursements.

Wages and salaries

In theory, there are two methods for the calculation of wages and salaries at constant prices. The first is to observe price changes of labour input and derive the volume change. The second is to observe quantity changes of labour input and derive the price change. However, in order to derive reliable results from the quantity approach detailed information on labour input is required that will be difficult to collect in practice. Therefore, only an example of a price approach is discussed here, assuming the availability of data on changes in contractual hourly wages for (large) groups of employees, for example collective agreements.

The price approach

The ideal price approach requires a breakdown of the wages and salaries paid by an industry into homogeneous groups of labour according to occupation, education level etc. The change in wages in each group consists of a number of components of which some have to be recorded as volume change and the other as price change. These components are:

1. Change of the contractual hourly wages: this is a *price* change
2. Change in the ratio "number of contractual hours" / "number of hours actually worked": this is a *price* change
3. Change in the number of hours actually worked: this is a *volume* change
4. Incidental changes in hourly wages resulting from growing skills of employees: this is a *volume* change
5. The results of intake and outflow of employees: this is a *volume* change

It has to be remarked that the classification of the five components into price and volume is an approximation: if growing skills of employees are not or insufficiently compensated by wage increases the change of the contractual wages is not a pure price change. A comparable problem arises when incidental changes in hourly wages exceed the increase of skills.

Neglecting the above-mentioned problem, the price approach requires the observation of the changes of hourly contractual wages of homogeneous groups of employees. Further information on the number of contractual hours as well as the number of hours actually worked is necessary. From these a price index for every separate group can be calculated. From the single price indices the aggregate Paasche price index can be derived by weighting with the wages by group. The volume index of total wages paid (Laspeyres) is derived from the value index and the Paasche price index.

The described price approach requires the availability of detailed and specific data. If not all data are available less precise approximations could be considered. If, for instance, a breakdown of wages into homogeneous groups is not available, but it is known that the changes of the contractual hourly wages are nearly the same for the important labour groups in an industry and that the ratio between actual hours worked and contractual hours worked does not change. Wages can be deflated by the change of the hourly contractual wage at the aggregate level.

Employers' social contributions

As argued before, the volume index of employers' social contributions should be equal to the volume index of wages and salaries. The price index can then be derived from the value index and the volume index. Since social security arrangements are often different for separate labour groups, depending on the level of wages, the ideal approach would be to calculate volume changes of wages and salaries at a detailed level and use these for the deflation of employers' social contributions also at the same level of detail. However, because of the lack of detailed data on social security by industry in practice the calculations will necessarily be at the aggregate level.

9.10.3 Deflation of other taxes and subsidies on production

The payment of other taxes on production is related to the use of certain inputs in the production processes or to socially unwelcome results of production processes. Examples of the former are taxes on real estate property and taxes on motorcars and motor-lorries owned by producers. An example of the latter is levies on pollution caused by a production process.

Taxes can be based on values (e.g. the value of a building) or quantities (e.g. tons of pollutants), implying that the deflation of other taxes on production is in principle comparable with the deflation of taxes on products and that the same formulae are applicable. However, in practice the deflation of other taxes on production is more difficult because of a serious lack of appropriate data. This holds for current prices as well as for constant prices.

Data on the total payments for each tax category are often available from the tax authorities. However, a serious problem is the time lag in the tax reception. Tax payments are generally paid in a different period than they refer to. Assuming a constant time lag often solves this problem. However, in practice time lags can differ between successive years.

Another problem is that data on the payment of other taxes on production paid for by separate industries are scarce and, if available, often incomplete and not divided by kind of tax. For estimates at constant prices an additional problem is the lack of appropriate indicators for price and volume. In theory, price indices could be derived from tariff information. In practice the tariff structure appears to be very complex and the required data are often not available, especially at the level of separate industries.

A proxy solution for the deflation problem

As a first step it is recommended to try to find a solution for the deflation problem at the macro-level: the total payments by industries. The main reason is that more reliable data are available at the macro level.

Suppose, for example, that at the macro level taxes on products are available divided by kind of tax, but at the level of industries only aggregated tax data are available. Also in this case it is preferable to carry out the deflation by separate kind of tax at the macro level and compile estimates on the industry level afterwards. The result will be more reliable estimates at the macro level.

Deflation of the total payments by tax category

In principle, applying price indicators or quantity indicators can be used to derive the value at constant prices of other taxes on production. However, because of the complexity of the tariff structure of most taxes and the lack of appropriate data, quantity methods will prevail. Another argument for the use of quantity data is that for several reasons, the actual tax revenues can differ from theoretical tax revenues. Reasons can be the time lag problem, non-ability of tax collection by the tax authorities, measurement errors, etc. In national accounts it is an important question how to deal with differences between the theoretical tax value index and the index of the real tax revenue: is it part of volume or of price? This is a choice between two evils: to affect the volume index or the price index. Both are important in national accounts.

However, there are two considerations providing a solution for the choice. The first is that in national accounts the estimation of volume growth rates is still somewhat more important than the estimation of price indices. Even more important is that non-collection in fact means lowering of the tax rate and therefore has to be seen as price. So, the difference has to be added to the price index and the volume index will not be changed. Therefore, it is recommended, when deflating taxes on production, firstly to estimate the volume index.

Suppose rev(t-1) and rev(t) are the actual tax revenues in t-1 and t. then the volume index is

$$= \Sigma \frac{rev(t-1) * [q(t) / q(t-1)]}{rev(t-1)}$$

and the value of t in prices t-1 is

rev(t-1) * [q(t) / q(t-1)].

The use of quantity indicators requires a direct link between them and the tax. For instance, the indicator for the tax on real estate property needs a direct relation to the amount of real estate property owned by producers. A candidate proxy indicator is the volume index of the total stock real estate property. The index of the total tons of emitted pollutants per kind of pollution tax could be an appropriate indicator for taxes on pollution.

The price indices are derived afterwards from the combination of the value index and the volume index. They can be applied for the deflation of the tax payments by industry.

Deflation of the tax payments by industry

The way the tax payments by a separate industry should be deflated depends of the amount of tax paid and the availability of data. If the tax payments at current prices for an industry are divided by kind of tax, the above-derived price indices for the total payments can be applied. If no separation by kind of tax is available, but tax payments are relatively small, the average (weighted) price index of the total of other taxes on production could be used as a proxy deflator. If no separation by kind of tax is available and tax payments are considerable, depending on the character of the production process, a (mixed) price index has to be chosen from the set of derived price indices by tax category.

Subsidies

The practical elaboration of constant price estimation of taxes on production presented above can be similarly applied to subsidies on production.

Outlook

In the compilation of national accounts, the supply and use tables are the balancing framework, in which the three methods for estimating the gross domestic product are applied and reconciled. In this role supply and use table determine the value and growth of a number of macroeconomic variables. The main goal is estimating gross domestic product and other macroeconomic variables, both in value, volume and price measures. Supply and use tables at basic prices constitute the best framework to deflate GDP on a commodity basis. Supply and use tables at current and constant prices provide a suitable framework for constructing a system of volume and price indices as well as ensuring the consistency of the macroeconomic data.

The Eurostat Handbook on Price and Volume measures in National Accounts states that the supply and use system is indeed an excellent framework through which price and volume measures can be established in a consistent and systematic way.

Tables linking the supply and use tables to the sector accounts

chapter 10

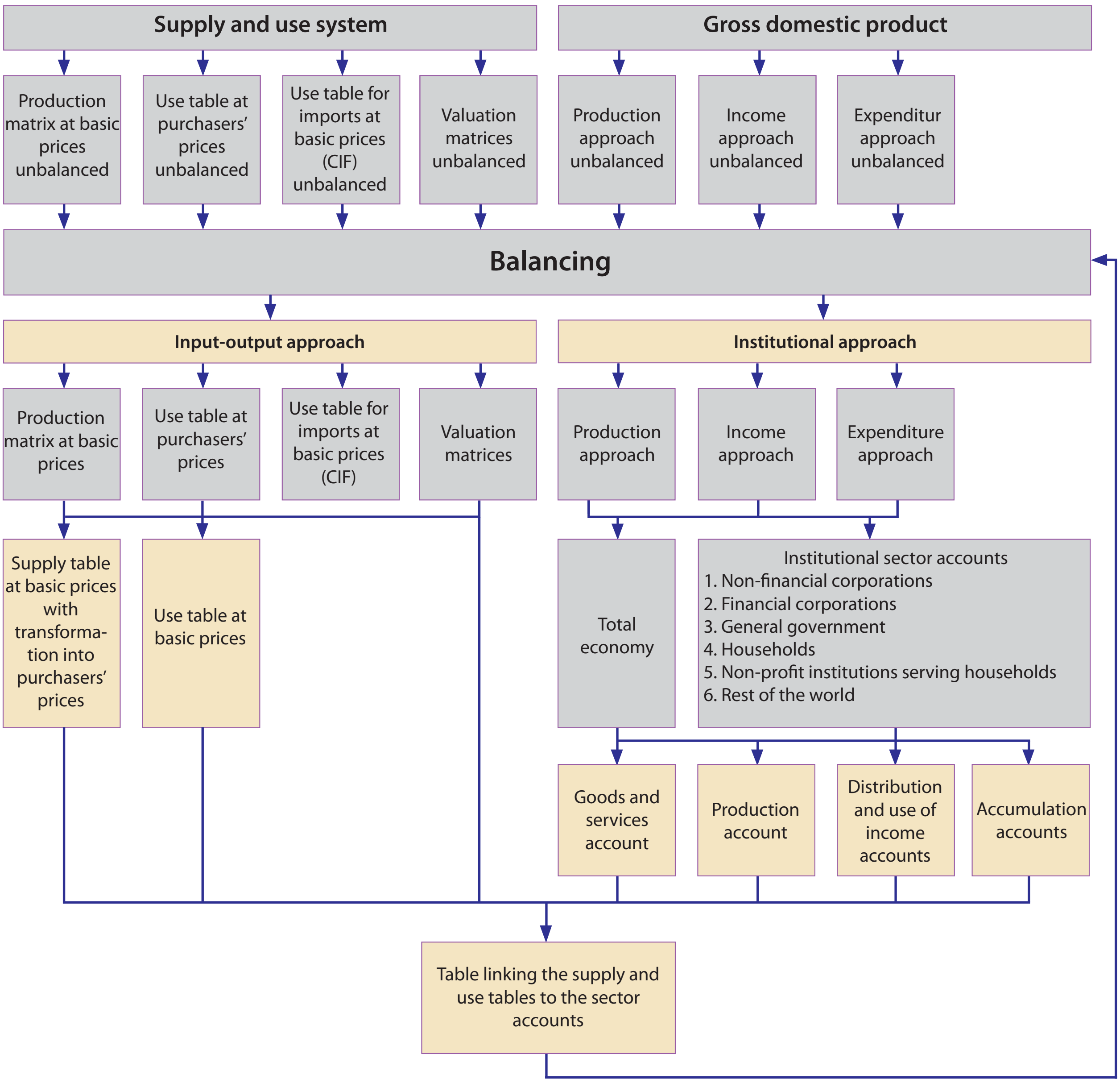
10.1 Introduction

The integration of the input-output framework into the core of the national accounts system is one of the most important new features of the SNA 1993, which were fully adopted by ESA 1995. Such an integrated system of national accounts provides sounder and more consistent estimates of macroeconomic data.

In the past, some European countries already used the input-output framework as a basis for the main national accounts estimates while other countries regarded supply and use tables and input-output tables as a luxury in the elaboration of the system of national accounts. However, those countries which managed to implement the integrated system are very pleased with the achievement.

The table linking the supply and use tables to the sector accounts is precisely the most appropriate expression of the important changes introduced by SNA 1993 and ESA 1995. However, before we discuss the differences and relations in detail, the two main approaches of the "input-output approach" and the "institutional analysis approach" of compiling macroeconomic data should be well understood.

Figure 10.1: Table linking the supply and use tables to the sector accounts



The information in the supply and use tables should be linked to the sector accounts to ensure that the supply and use tables are consistent with the sector accounts. This is achieved by introducing a table with variables cross-classified by institutional sectors in the rows and by industries in the columns. Figure 10.1 demonstrates how a table can be established for a balanced system of national accounts which links the main macroeconomic variables of supply and use tables to the sector accounts.

Table 10.1: Supply and use tables at purchasers' prices

Supply table at basic prices, including a transformation into purchasers' prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)							IMPORTS				VALUATION		
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total domestic output at basic prices	Intra EU imports CIF	Extra EU imports CIF	Imports CIF	Total supply at basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Products of agriculture	6 467						6 467	1 039	874	1 912	8 380	1 903	- 262	10 021
2	Products of industry	889	111 350	626	2 749	62	248	115 925	48 544	24 269	72 812	188 737	36 181	15 988	240 906
3	Construction work	140	1 132	27 356	429	36	67	29 161	217	143	360	29 521		1 704	31 225
4	Trade, hotel, transport services	150	3 375	399	79 355	447	439	84 164	2 044	1 512	3 557	87 721	- 38 085	1 696	51 332
5	Private services	13	1 428	211	1 953	66 939	416	70 961	3 580	1 493	5 073	76 033		2 722	78 756
6	Other services	4	58	5	200	2	55 843	56 112	559	281	840	56 952		850	57 802
7	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790	55 983	28 571	84 554	447 344	0	22 699	470 043
8	CIF/FOB adjustments on imports								- 133	- 30	- 163	- 163			- 163
9	Direct purchases abroad by residents								4 997	3 160	8 157	8 157			8 157
10	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790	60 847	31 701	92 548	455 338	0	22 699	478 037

Use table at purchasers' prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES (NACE)							FINAL USES									
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit institutions	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exportsextra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	1 705	4 104	30	482	11	95	6 426	2 561		176	108		242	397	112	3 595	10 021
2	Products of industry	1 678	55 020	9 212	14 043	3 701	7 730	91 384	55 434		2 111	22 231	163	792	42 232	26 561	149 522	240 906
3	Construction work	99	542	1 993	950	3 695	1 445	8 724	1 032			20 761			429	280	22 501	31 225
4	Trade, hotel, transport services	83	4 420	401	11 129	1 321	1 493	18 847	26 586		328	67			3 285	2 223	32 488	51 334
5	Private services	171	7 400	1 732	10 490	21 810	4 618	46 221	22 156		195	4 254		- 24	3 606	2 345	32 533	78 754
6	Other services	102	1 323	77	813	1 682	3 052	7 049	9 507	3 670	36 988	251	61		187	90	50 753	57 802
7	Total	3 837	72 808	13 445	37 907	32 221	18 433	178 652	117 274	3 670	39 797	47 672	224	1 009	50 135	31 611	291 392	470 043
8	CIF/FOB adjustments on exports														- 133	- 30	- 163	- 163
9	Direct purchases abroad by residents								8 157								8 157	8 157
10	Domestic purchases. by non-residents								- 12 360						9 528	2 832		
11	Total	3 837	72 808	13 445	37 907	32 221	18 433	178 652	113 071	3 670	39 797	47 672	224	1 009	59 530	34 413	299 386	478 037
12	Compensation of employees	504	25 517	8 298	26 129	14 458	32 269	107 174										
13	Other net taxes on production	- 906	908	345	981	883	810	3 021										
14	Consumption of fixed capital	1 520	6 407	1 007	6 634	9 363	4 642	29 574										
15	Operating surplus, net	2 709	11 705	5 501	13 036	10 561	859	44 370										
16	Value added at basic prices	3 826	44 536	15 152	46 779	35 265	38 580	184 138										
17	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790										

Production approach		Income approach		Expenditure approach	
Total output at basic prices	362 790	Compensations of employees	107 174	Household final consumption expenditure	113 071
- Intermediate consumption at purch. prices	-178 652	+ Other net taxes on production	3 021	+ NPISH final consumption expenditure	3 670
		+ Capital consumption	29 574	+ Government consumption expenditure	39 797
		+ Net operating surplus	44 370	+ Gross fixed capital formation	47 672
				+ Changes in inventories	224
= Value added at basic prices	184 138	= Value added at basic prices	184 138	+ Acquisitions less disposals of valuables	1 009
				+ Exports of goods and services	93 943
+ Taxes less subsidies on products	22 699	+ Taxes less subsidies on products	22 699	- Imports of goods and services	-92 548
= Gross domestic product	206 837	= Gross domestic product	206 837	= Gross domestic product	206 837

Austria 2000

In Table 10.1 the supply and use tables at purchasers' prices are presented which are used as reference for the table linking the supply and use tables to the sector accounts. The supply table at basic prices, including a transformation into purchasers' prices, and the use table at purchasers' prices are part of the official transmission programme for ESA 1995.

10.2 Production accounts and generation of income accounts

Among the sector accounts, the production accounts and the generation of income accounts are important for balancing the supply and use tables and the sector accounts. Table 10.2 and Table 10.3 give an empirical example of the balanced production accounts and generation of income accounts.

Table 10.2: Production account

USES			RESOURCES		
P.2	Intermediate consumption	178 652	P.1	Production	362 790
B.1b	Gross domestic product	206 837	P.11	Market production	310 486
K.1	Consumption of fixed capital	179 496	P.12	Production for own final use	16 070
B.1n	Net domestic product	27 342	P.13	Other non-market production	36 234
			D.2-D.3	Taxes less subsidies on products	22 699
			D.2	Taxes on products	25 237
			D.3	Subsidies on products (-)	-2 538
	Total	385 489		Total	385 489

Austria 2000

The production account shows the transactions of the production process. It is elaborated for:

- Institutional sectors and industries

  Resources are made up of production (market production, own final use, non market production) minus use for intermediate consumption. The obtained balance is the value added and the value generated by any unit devoted to a production activity. The value added may be calculated discounting or not discounting consumption of fixed capital, i.e. gross or net.

- The total economy

  Besides the above mentioned variables, the resources of the accounts include taxes minus subsidies on products. This allows obtaining, as a balance, the gross domestic product at market prices, for which a summarised comment is given in the paragraph below.

Table 10.3: Generation of income account

USES			RESSOURCES		
D.1	Compensation of employees	107 174	B.1	Gross domestic product	206 837
D.11	Salaries and wages	85 891			
D.12	Social contributions paid by the employers	21 283			
D.29	Other taxes on production	6 505			
D.39	Other subsidies (-)	-3 484			
B.2/B.3	Gross operating surplus/mixed income	73 944			
D.2-D.3	Taxes less subsidies on products	22 699			
	Total	206 837		Total	206 837

Austria 2000

The generation of income account in Table 10.3 analyses how far the value added covers the compensation of wage earners and other taxes less other subsidies on production. By subtracting compensation of employees and other net taxes on production from value added at basic prices, gross operating surplus is compiled as a residual variable. It represents the compensation of capital for the use of different production assets. However, in many industries, in particular in agriculture and trade it also represents the labour income of self-employed persons.

The gross (or net) operating surplus of the total economy equals the sum of the gross (or net) operating surplus of the different institutional sectors or industries.

ESA 1995 revives the concept of mixed income which is equal to the operating surplus but only in the case of non-corporate enterprises in the households sector. This traditional concept of economic theory and early national accounts versions has been retrieved for SNA 1993 and ESA 1995. The expression “mixed income” arises from the fact that when it is used, for example, for farmers or individual entrepreneurs (provided they are non-corporate), the primary income from processes of production cannot clearly be attributed to any of the basic factors such as labour and capital. Regarding this matter, ESA 1995 specifies the production of rental services of owner occupied dwellings as operating surplus in the generation of income account.

As in other cases, the gross (or net) mixed income of the total economy equals the gross (or net) mixed income of the households sector.

10.3 Input-output and functional analysis in the ESA 1995

ESA 1995 aims to build a schematic (though complete) description of how an economic system operates. Taking into account the complexity of the real economy, a simplification as well as a basic aggregation of its elements must be attained, in order to facilitate understanding. The aggregation is carried out from different viewpoints of institutional units engaged in economic transactions and activities of industries.

Regarding the aggregation of entities or units for the ESA 1995, two approaches are considered for their classification and for the measurement of the real economy.

- In the input-output approach, the analysis by products and industries emphasises the production processes, the flows of goods and services, and the use of primary inputs (capital, labour). The balance between supply (resources) and demand (uses) of products constitutes the central element of this type of functional analysis.
- In the institutional approach, the analysis focuses on the generation and distribution of income, and the investment and financing of capital by institutional sectors.

Box 10.1: Institutional sectors in ESA 1995

In the following table the type of producer and principal activity and functions are listed for the main institutional sectors.

SECTOR	TYPE OF PRODUCER	PRINCIPAL ACTIVITY AND FUNCTION
Non-financial corporations (S.11)	Market producer	Production of market goods and non-financial services
Financial corporations (S.12)	Market producer	Financial intermediate including insurance. Auxiliary financial activities
General government (S.13)	Public other non-market producer	Production and supply of other non-market output for collective and individual consumption and carrying out transactions intended to redistribute national income and wealth
Households (S. 14) as consumers	No producer	Consumption
Households (S. 14) as entrepreneurs	Market producer or private producer for own final use	Production of market output and output for own final use
Non-profit institutions serving households (S.15)	Private other non-market producer	Production and supply of other non-market output for individual consumption

To tackle these two types of analysis, different use is made of a classification of the economy into elementary units with specific characteristics according to either approach:

- For the *input-output approach* units are chosen that reflect technical-economic relations, i.e. units of production, local kind of activity units or units of homogeneous production. In consequence, economic activities are studied from the viewpoint of the specific units that carry out the production. In other words, the elements of the system are classified according to their productive activity.
- For the *institutional approach* units are chosen that reflect the general economic behaviour of “institutional units” in the form of legal or social entities. These units are classified according to their main functions, behaviour and objectives. Examples of institutional units are households or enterprises (corporations).
- The aggregation of elementary units leads to aggregated units. Functional units are aggregated to homogenous units of production, industries or branches of activity (agriculture, industry, etc.). Institutional units lead to institutional sectors (non-financial corporations, financial institutions, general government, households, and non-profit institutions serving households).

Box 10.1 lists the main institutional sectors by type of producer and principal activity and function and summarises these differences.

Table 10.4 compares three defining aspects of the input-output approach and the institutional approach: the objectives pursued by either of the above mentioned approaches; the types of accounts; and the types of units.

As far as accounts are concerned, the perspective of the input-output approach is in principle more limited than that of the institutional approach. For the input-output approach, only three accounts are used (goods and services, production, and generation of income approach). However, in the input-output approach these three accounts are elaborated in detail for each industry.

Table 10.4: Main features of input-output approach and institutional approach

	INPUT-OUTPUT APROACH	INSTITUTIONAL APPROACH
OBJECTIVES	Production relationships Goods and services flows (equilibrium of resources and uses)	To record the economic data of units with decision-making autonomy and a similarity in terms of their principal functions, behaviour and objectives
ACCOUNTS	- Goods and services account - Production account - Generation of income account (Integrated in the input-output framework)	A complete system of accounts (income, expenditure, financial flows, and balance sheets)
TYPES OF UNITS		
Elementary	Production units (LKAU, HPU, etc.)	Institutional units (households, corporations, etc.)
Aggregates	Industries (branches of activity)	Institutional Sectors

It should be noted that the differentiation between the input-output approach and the institutional approach considered so far and shown in the above table, is up to a point merely conventional. It is useful to explain the contents of ESA 1995 but it implies a high degree of simplification. These two types of analysis are not independent. Quite the contrary is true. Both systems should complement each other. This is the main reason why the system of national accounts is regarded as an integrated system for the measurement of economic activity. Thus, when the input-output approach studies the activity of a production unit and how its value added is distributed between compensation of employees and gross operating surplus, information is in fact supplied on the (primary) distribution of income. Moreover, units devoted to production activity, will depend on institutional units (Cañada 1997).

Further, aggregated variables in the overall economy (production, income, etc.) will obviously have the same value, regardless of the original approach (industries or sectors). Within these two main types of analysis, the input-output framework may be considered as the core element of the input-output approach. This core characteristic arises from the fact that the input-output synthesis can cover with a relatively small set of matrices all elements of economic activities and provide additional information with attached satellite systems.

10.4 Description of the cross table

The input-output approach and the institutional approach are two complementary approaches to describe how the economic system operates. This is the main purpose of national accounts. In fact, the introduction of the sector by industry table (cross table) into the input-output framework, clearly illustrates the integrated character of both perspectives.

The cross table supplies the following information for sectors and industries:

- Transactions of production accounts: production, intermediate consumption.
- Transactions of the generation of income account: compensation of employees
- Transactions of the accumulation accounts: gross fixed capital formation.

The cross table records data of three specific sector accounts of the whole system: The production account, the generation of income account and the accumulation account broken down simultaneously by industries and by institutional sector. In this way, the systems' interrelations become clear and from the point of view of estimates, their coherence is warranted in both fields of the sector accounts and the input-output framework.

Table 10.5 presents the cross table between supply and use table and sector accounts. The table includes the main macroeconomic information on output, intermediate consumption, gross value added, and gross fixed capital formation for each industry and the main institutional sectors.

Table 10.5: Table linking the supply and use tables to the sector accounts

	INDUSTRIES (NACE)				Total
	1	2	…	n	
INSTITUTIONAL SECTORS					
1. Non-financial corporations					
Total output					
Market output					
Output for own final use					
Other non-market output					
Intermediate consumption					
Gross value added					
Compensation of employees					
Other net taxes on production					
Consumption of fixed capital					
Operating surplus, net					
Gross fixed capital formation					
2. Financial corporations					
Total output					
:					
Gross fixed capital formation					
3. General government					
Total output					
:					
Gross fixed capital formation					
4. Households					
Total output					
:					
Gross fixed capital formation					
5. Non-profit institutions serving households					
Total output					
:					
Gross fixed capital formation					
6. Total					
Total output					
:					
Gross fixed capital formation					

The institutional sectors cover

- non-financial corporations,
- financial corporations,
- general government,
- households, and
- non-profit institutions serving households.

An empirical example of a corresponding cross table between supply and use tables and sector accounts is given in Table 10.6. The information in the supply and use tables is linked to the sector accounts, to ensure that the supply and use tables are consistent with the sector accounts.

Table 10.6: Empirical example of a table linking the supply and use tables to the sector accounts

	INDUSTRIES (NACE)					Total
	Agriculture, hunting and related service activities	Forestry, logging and related service activities	…	Other service activities	Private households with employed persons	
	1	2	…	58	59	
INSTITUTIONAL SECTORS						
1. Non-financial and financial corporations, households						
Total output	5 714	1 735		1 621	454	322 590
Market output	5 551	1 735		1 619	0	306 547
Output for own final use	164	0		2	454	11 310
Other non-market output	0	0		0	0	4 733
Intermediate consumption	2 924	836		484	0	166 079
Gross value added	2 790	899		1 137	454	156 511
Compensation of employees	270	123		776	454	81 760
Other net taxes on production	- 897	- 12		34	0	2 251
Consumption of fixed capital	1 381	107		103	0	26 197
Net operating surplus	2 036	681		224	0	46 304
Gross fixed capital formation	1 554	112		204	0	44 184
2. General government						
Total output	190	6		57	0	35 434
Market output	6	6		57	0	3 912
Output for own final use	0	0		0	0	24
Other non-market output	184	0		0	0	31 498
Intermediate consumption	60	5		32	0	10 889
Gross value added	130	1		25	0	24 545
Compensation of employees	108	2		32	0	22 736
Other net taxes on production	2	0		2	0	623
Consumption of fixed capital	30	1		23	0	3 119
Net operating surplus	- 11	- 2		- 32	0	-1 934
Gross fixed capital formation	36	1		13	0	3 148
3. Non-profit institutions serving households						
Total output	0	0		0	0	4 766
Market output	0	0		0	0	27

Output for own final use	0	0		0	0	4 736
Other non-market output	0	0		0	0	3
Intermediate consumption	0	0		0	0	1 684
Gross value added	0	0		0	0	3 082
Compensation of employees	0	0		0	0	2 678
Other net taxes on production	0	0		0	0	147
Consumption of fixed capital	0	0		0	0	257
Net operating surplus	0	0		0	0	0
Gross fixed capital formation	0	0		0	0	340
4. Total						
Total output	5 904	1 741		1 678	454	362 790
Market output	5 557	1 741		1 676	0	310 486
Output for own final use	164	0		2	454	16 070
Other non-market output	184	0		0	0	36 234
Intermediate consumption	2 984	841		517	0	178 652
Gross value added	2 920	900		1 161	454	184 138
Compensation of employees	377	125		808	454	107 174
Other net taxes on production	- 894	- 11		35	0	3 021
Consumption of fixed capital	1 412	107		127	0	29 574
Net operating surplus	2 025	680		192	0	44 370
Gross fixed capital formation	1 590	112		217	0	47 672

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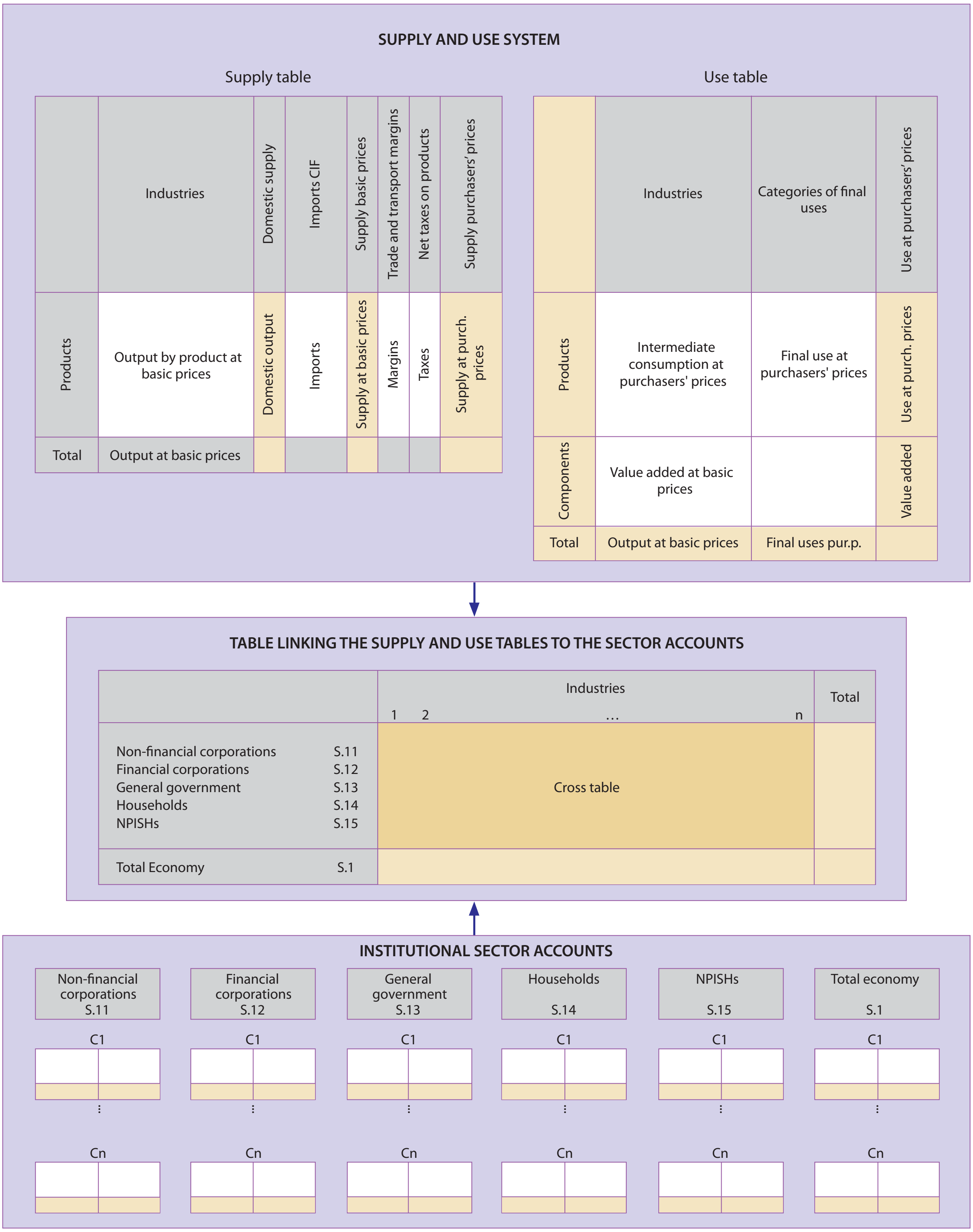
10.5 Compilation aspects

10.5.1 Functional aspects in the use of information

With the tables linking the supply and use tables to the sector accounts, a direct comparison can be made with information from the supply and use table and the sector accounts.

Figure 10.2: The compilation of the cross matrix



This at least guarantees that after the balancing process consistency is obtained between the supply and use tables and the sector accounts. This statement of SNA 1993 is a recommendation for an ex-post compilation of this table. After independently compiling supply and use tables and institutional sector accounts, the cross table may be established to check the consistency of results.

More explicitly, Figure 10.2 represents the proposed procedure: the supply and use system on the one hand and institutional sector accounts on the other hand, will be independently compiled. In a second stage, the comparison between the two types of information can be made in the cross table. In the usual case of incompatibilities of data, a revision process will start on both approaches until a new assessment is reached.

However, some other possibilities of compilation methods could be analysed, as recorded in Table 10.7.

In Method A the two approaches are elaborated in an independent way. The unique possible role of the cross matrix is to contrast them and to help in the reconciliation process.

Method B and Method C represent two opposite alternatives in the compilation of National Accounts. Method B focuses on the production input-output methods and corresponding sources of information. Method C promotes the institutional sectors from which input-output elements will be derived. In both alternatives the role of the cross matrix is similar. It represents the missing link between the two approaches. When the input-output approach is the starting point, the cross matrix gives data for the first two accounts of institutional sectors - production and generation of income accounts. In case institutional sector accounts are the main and initial stage, the cross matrix helps to distribute data over the different industries as a first stage of the compilation of input-output system.

Table 10.7: Different compilation methods for national accounts and the role of the cross input-output/ institutional matrix

GENERAL STRUCTURE OF THE NATIONAL ACCOUNTS COMPILATION PROCEDURE	THE ROLE OF THE CROSS MATRIX IN THE COMPILATION PROCESS
Method A Independent compilation of input-output framework and institutional sectors accounts.	Ex-post reconciliation of both approaches.
Method B Compilation based on instruments and statistical sources of input-output framework as a core element with a secondary role of institutional sectors accounts.	The cross matrix would be the first stage in the compilation of institutional sectors accounts.
Method C Compilation based on instruments and statistical sources of institutional sectors accounts with a secondary role of input-output framework.	The cross matrix would be the first stage in the compilation of input-output framework.
Method D Simultaneous compilation of input-output framework and institutional sectors accounts.	The cross matrix as a central instrument in the compilation of the system of national accounts.

The question here is whether, in an ideal system, it would not be possible to suggest an “optimal” process of compilation which starts simultaneously from an institutional and an input-output perspective. This is Method D.

What would be the advantages of this suggestion? Obviously, it would mean that the two different kinds of perspectives are totally compatible from the very beginning of the national accounts compilation. In terms of the relevance of the cross table, such a proposal means that the table is in the core of all the compilation process.

Of course, the statistical requirements for this optimal proposal are enormous. The implicit main aspect is that the databases should be structured according to the institutional sector with which they are associated (non-financial corporations, financial institutions, public administrations, households, non profit institutions serving households, rest of the world). As indicated in the table, there are five basic types of information required (broken down by institutional sectors) to prepare the input-output framework:

- Production data broken down into matrixes by products and industries and valued at basic prices.
- Intermediate consumption data, broken down by products and industries and valued at purchasers' prices.
- Data on the cost of primary inputs, particularly wage earners compensations (with a breakdown of wages and salaries and employers' social contributions), and consumption of fixed capital. These data should be disaggregated by industries.
- Data on the gross fixed capital formation and stock variations broken down by types of products and industries. In the case of gross fixed capital formation, the data are valued at purchasers' prices, while in the case of stock variations the data are shown at basic prices.
- Data on labour input broken down by the employers' industries and by employment category (wage and salary earners, self-occupied). Also defined by the amount of people employed and hours worked.

In short, there are important information requirements, which call for the availability of complete and detailed basic economic statistics. An asset of such an ambitious database is the possibility of a simultaneous compilation of the cross matrix and the improvement of all requirements to compile the national accounts:

- One of the table's main advantages is that it allows the possibility to state and analyse the different types of production (market, non-market, for own final use) which depend on the institutional approach, following the ESA 1995 criteria. Definition of the concepts of market output, output for own final use and other non-market output can only be understood by looking also at features of the institutional unit and the local KAU that produce that output. The distinctions are defined in a top-down way, i.e. the distinction is first defined for institutional units, then for local KAUs and then for their output.
- The simultaneous compilation of institutional/industries aspects is a prerequisite for the estimation of "value-added" type of taxes. If some details of intermediate consumption and gross fixed capital formation are available in the suggested approach, then it is possible to achieve a more accurate compilation of VAT.
- The cross table allows a clear identification of non-market household production activities: the (imputed) production of rental services of owner occupied dwellings; output of household services produced by employing paid staff; own-account construction, etc.

10.5.2 Institutional aspects in the use of information

From business accounting to national accounting

Table 10.8 gives a summary of the main requisites to compile institutional/functional transactions simultaneously. However, in economic statistics surveys, data are not initially presented in the same format. Generally speaking, this is the result of criteria that differ from those of national accounts. For example, in the case of companies included in the non-financial corporations sector, the available data will normally follow business accounting criteria, which differ in several aspects from national accounting criteria.

In fact, the trend in recent years has been to bring most economic statistics in line with corporate accounting standards. The advantage of this is clear: By facilitating the job of those being surveyed, the response rate is increased and thus the quality of the statistics improved. However, the drawback is that this process requires a greater effort to adapt the figures to the national accounting framework.

This leads to one of the additional tasks of national accounting: the definition of an intermediate system, which connects these two accounting realms and makes them compatible. A first simple approach to national accounting based on corporate accounting is:

Turnover
+/- Change in stocks of finished products and work in progress manufactured by the unit
+/- Change in stocks of goods purchased for resale in the same condition as received
- Purchases of goods and services purchased for resale in the same condition as received
+ Own account production
- Taxes on products

+ Subsidies on products
= Production value at basic prices

Purchases of goods and services
- Purchases of goods and services purchased for resale in the same condition as received
+/- Change in stocks of raw materials and consumables
= Intermediate consumption at purchasers' prices

Wages and salaries
+ Employers' social contributions
+ Other net taxes on production
+ Consumption of fixed capital
+ Net operating surplus
= Value added at basic prices

Table 10.8: Structure of optimal database information

TRANSACTION	BREAKDOWN	VALUATION TYPE
Output	Matrix by products, industries and institutional sectors	Basic prices
Intermediate consumption	Matrix by products, industries and institutional sectors	Purchasers' prices
Compensation of employees	Matrix by components (wages and salaries, contributions), industries and institutional sectors.	---------
Fixed capital consumption	Matrix by products, industries and institutional sectors	---------
Gross fixed capital formation	Matrix by products, industries and institutional sectors	Purchasers' prices
Changes in inventories	Matrix by products, industries and institutional sectors	Basic prices
Labour input	Matrix by categories (wage earners, non-wage earners, hours worked), industries and institutional sectors	---------

Once the first estimates of these variables are obtained, adjustments should be made to adapt them to ESA 1995 concepts.

One important problem is the valuation of stock variations. Corporate accounting may follow different recording methods (LIFO, FIFO, NIFO, etc.) whereas for national accounting it will be necessary to know the variation in the stocks volume and prices before adapting it to the appropriate valuation.

Gross fixed capital formation should be treated separately. Usually, it is not possible to value it on the basis of annual accounts. It is necessary to resort to the varying balances of two consecutive years or to the enterprises' records which normally minutely state the purchases of capital assets. Also, business accounting does not usually yield direct information on employment (although it does on employment costs). It is therefore necessary to resort to complementary information of activity reports, records or surveys, in order to calculate the hours worked and the number of wage earners.

Public finance and national accounting

Another kind of intermediate system in the process of compilation of the cross table and the complete input-output framework is the linkage of public accounting and national accounting. In this case, differences are not as relevant as in the previous item (between business and national accounting); in fact, many public finance systems in Europe have introduced the intermediate systems of ESA 1995 in their data. In this case, it is possible to simultaneously know the main figures of the two approaches.

As a practical rule for compilation, the best solution is, as in many other cases, to co-ordinate public accounts and national accounts. In particular, when a change in the national accounts benchmark year is introduced, a coordination of accounts is feasible. The main aspects of the integrated compilation process are the delimitation of general government sector and the identification of taxes and other receipts.

Regarding methodological references, an interesting instrument to facilitate the comparison between the two fields, public finance and national accounting, is the "ESA 1995 Manual on Government Deficit and Debt", published in 2000. It analyses, using numerical examples, most of the differences between the two accounting methodologies.

The problem of vertically integrated enterprises and the delimitation of local kind of activity units

In SNA 1993 the horizontally integrated enterprise is defined:

> *A horizontally integrated enterprise is one in which several different kinds of activities which produce different kinds of goods or services for sale on the market are carried out in parallel with each other. It follows from the definition of an establishment that a separate establishment should normally be identified for each different kind of activity.*

However, another problematic link to the use of business accounts in the field of national accounts is the vertically integrated enterprise. SNA 1993 specifies the following definition:

> *A vertically integrated enterprise is one in which different stages of production, which are usually carried out by different enterprises, are carried out in succession by different parts of the same enterprise. The output of one stage becomes an input into the next stage, only the output from the final stage being actually sold on the market. There are numerous examples of vertically integrated enterprises.*

From the perspective of compiling the cross matrix compilation perspective, major problems arise from vertically integrated enterprises. Business accounting data will be consolidated, without specific detail on the stages and intra-enterprise transactions involved among the different units. This causes difficulties in distinguishing: intermediate consumption and other current costs as output of one stage which is, for example, intermediate consumption of another stage. Moreover, gross operating surplus may not be differentiated among the different parts of the enterprise.

Furthermore, the recommendations of SNA 1993 could be taken into account:

> *Despite the practical difficulties involved in partitioning vertically integrated enterprises into establishments, it is recommended that when a vertically integrated enterprise spans two or more headings at the first level of breakdown of the NACE, at least one establishment (local KAU) must be distinguished within each heading. The first breakdown of activities in the NACE corresponds to broad industry groups such as agriculture, fishing, mining and quarrying, manufacturing, etc.*

10.6 Analytical applications of the cross table

Besides the importance for the improvement of national accounts estimates, the cross table may also be used as an analytical tool, since the table provides the user of national accounts with relevant information: on each industry and the role of the different institutional sectors.

In fact, as a rule and despite all the unavoidable exceptions, it is possible to analyse the relations between the size and some other (for instance, technological) characteristics of enterprises and institutional sectors. The connection is usually that large-sized and/or highly technological enterprises are related to non-financial corporations (S. 11) and small-sized and/or scarcely technological enterprises to households (S.14).

Therefore, to ascertain the weight of both types of units for each industry, useful information such as the varying role of family enterprises in some activities should be collected. For technological and economic reasons, “family” enterprises obviously prevail in agriculture and services, though differences between countries may be very significant as far as industry is concerned.

If this information also contains data on employment, it is possible to relate productivity or income (compensation of employees and operating surplus) according to wage earners. Another very interesting analytic possibility is to assess the importance of public sectors as a producer of activities.

Thanks to the ESA 1995 minimum breakdown, some parts of this information are now available. For instance, the minimum breakdown of 60 activities recommended by ESA 1995 (two digits in NACE) makes it possible to analyse the role of the government in the supply of services such as health, education or financing.

Transformation of supply and use tables to symmetric input-output tables

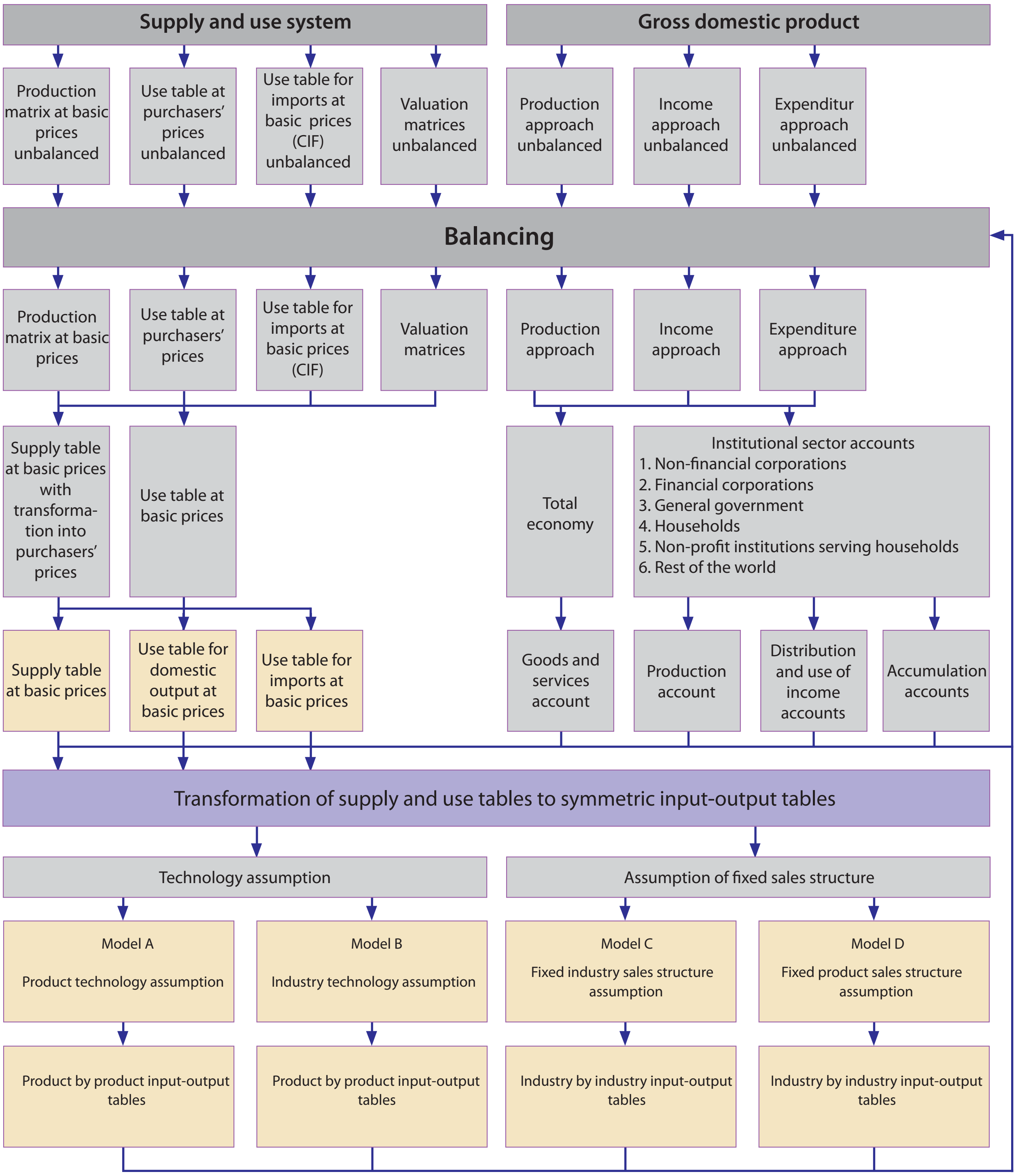
chapter 11

eurostat

11.1 Introduction

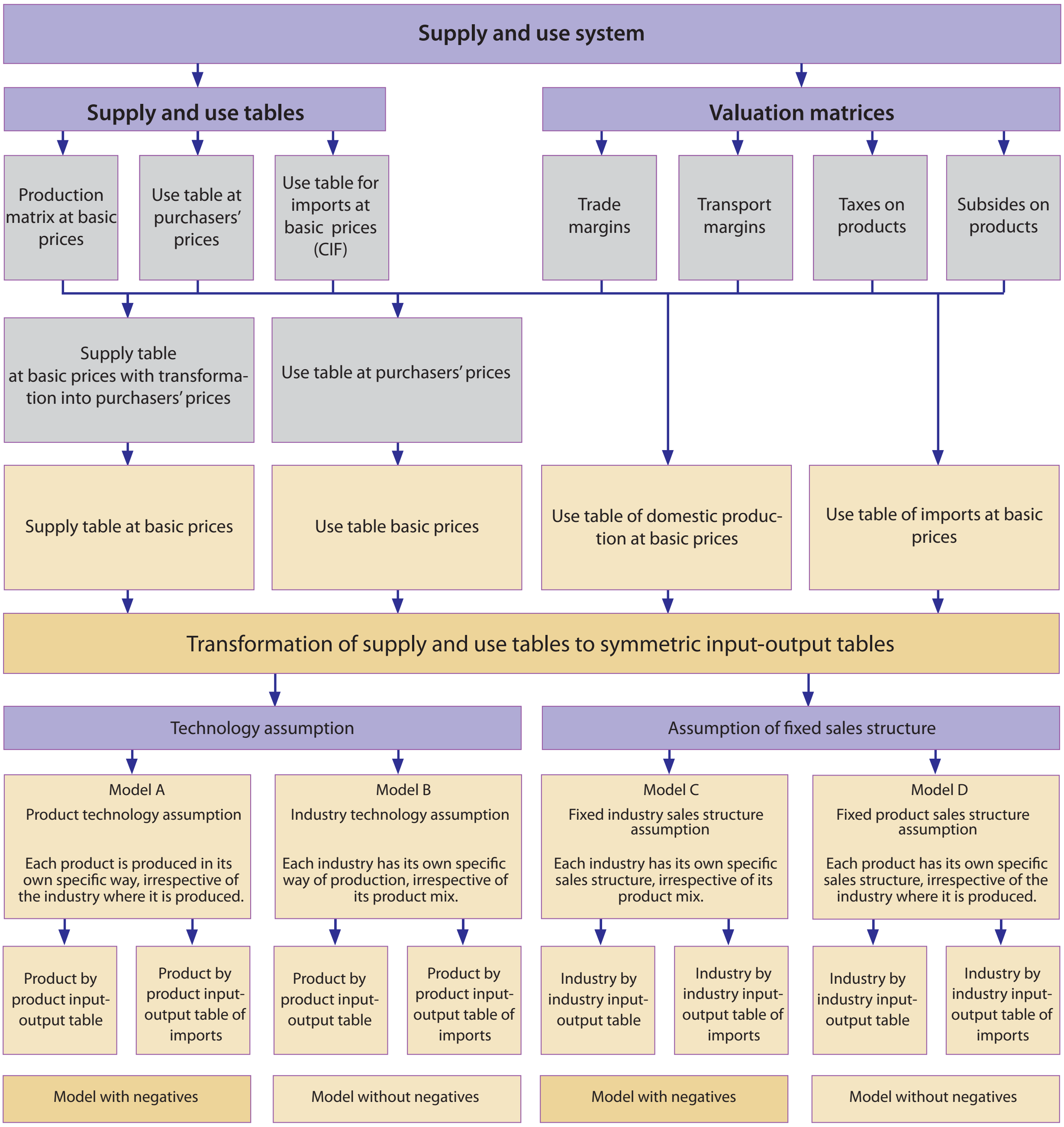
Supply and use tables (SUT) form a central part of the system of national accounts. Their main use is to act as an integration framework for balancing the national accounts (Figure 11.1). They also constitute the data base from which the data base for macroeconomic models and impact analysis can be derived in the form of symmetric input-output tables. The intermediate part of supply and use tables is in principle *rectangular*: the number of products and industries distinguished do not have to be equal. In practice, often many more products than industries are distinguished.

Figure 11.1: Supply and use tables and symmetric input-output tables in the system of national accounts



Four basic models for the transformation of supply and use tables to symmetric input-output tables will be discussed in detail. They include two models which are based on technology assumptions which will generate product-by-product input-output tables. In this case the input-output tables are comprised of homogeneous products in the rows and homogeneous units of production (branches) in the columns. The other two basic models are based on assumptions of fixed sales structures and generate industry-by-industry input-output tables. The results are input-output tables with products provided by industries in the rows and industries in the columns. In the manual these two prototypes of symmetric input-output tables are called product-by-product input-output tables and industry-by-industry input-output tables.

Figure 11.2: Transformation of supply and use tables to symmetric input-output tables



The transformation of supply and use tables to symmetric input-output tables requires a set of supply and use tables at purchasers' prices and valuation matrices from which supply and use tables at basic prices can be compiled with separate results for domestic output and imports. The supply and use tables at basic prices constitute the database which is required for the transformation of supply and use tables to input-output tables. This approach is visualised in Figure 11.2. Four standard models can be used for the transformation to product-by-product input-output tables or industry-by-industry input-output tables.

The four basic transformation models are based on the following assumptions:

- Product technology assumption (Model A)
  Each product is produced in its own specific way, irrespective of the industry where it is produced.
- Industry technology assumption (Mode B)
  Each industry has its own specific way of production, irrespective of its product mix.
- Fixed industry sales structure assumption (Model C)
  Each industry has its own specific sales structure, irrespective of its product mix.
- Fixed product sales structure assumption (Model D)
  Each product has its own specific sales structure, irrespective of the industry where it is produced.

Two other transformation models will be discussed: the hybrid technology assumption and the Almon procedure. The hybrid technology assumption combines the product technology assumption and the industry technology assumption to avoid negatives in product-by-product input-output tables. The Almon procedure is a mathematical algorithm designed for compiling product-by-product input-output tables which are based in essence on the product technology assumption but avoids by step-by-step procedure negatives in the derived input-output tables.

The System of National Accounts 1993 (SNA 1993) states that the input-output tables and in particular the supply and use tables serve two purposes: statistical and analytical. They provide a framework for checking the consistency of statistics on flows of goods and services obtained from quite different statistical sources – industrial surveys, household expenditures inquiries, investment surveys, foreign trade statistics etc. The supply and use system serves as a coordinating framework for economic statistics, both conceptually for ensuring the consistency of definitions and classifications used and as an accounting framework for ensuring the numerical consistency of data drawn from quite different sources. The input-output framework is also appropriate for calculating much of the economic data contained in the national accounts and for detecting weaknesses. This is in particular important for the decomposition of flows of goods and services into prices and volumes for the calculation of an integrated set of prices and volume measures. As an analytical tool, input-output data are conveniently integrated into macroeconomic models in order to analyse the link between final demand and industrial output levels. Input-output analysis also serves a number of other analytical purposes such as impact analysis, productivity analysis, employment effects, analysis of interdependence structures and analysis of price change.

11.2 Conversion of the supply and use tables to symmetric tables

11.2.1 Data base for the transformation

The data base for the transformation of symmetric input-output tables from supply and use tables comprises the following tables:

- Supply tables at basic prices
- Use table at basic prices
- Use tables for domestic output at basic prices
- Use tables for imports at basic prices.

The use table at basic prices is a step towards the conversion to analytical input-output tables. Intermediate and final uses calculated at basic prices are one step further removed from basic statistics and actual observations.

In a supply system at basic prices, the columns for trade and transport margins and net taxes on products become irrelevant in the supply table as the valuation matrices were deducted from the use table at purchasers' prices. However, non-deductible taxes less subsidies on products form an additional row in the use tables, as total uses continue to be valued at purchasers' prices.

In the supply and use tables presented so far, imports are shown by products in the supply tables, while not distinguished among uses in the use tables. In this recording, no information is required on the origin of products used by each category of demand. In most analyses the impacts of a certain level of final demand on production of resident producers and on imports need to be assessed separately.

The most comprehensive method is to prepare separate input-output tables for domestic output and imported products which were derived from the supply and use system.

Empirical examples of the required database for the transformation are given in Table 11.1 (Supply and use tables) and in Table 11.2 (Use tables for domestic output and imports).

Table 11.1: Supply and use tables at basic prices

Supply table at basic prices

	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE)							IMPORTS			Total supply at basic prices
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Intra EU imports CIF	Extra EU imports CIF	Imports cif	
No		1	2	3	4	5	6	7	8	9	10	11
1	Products of agriculture	6 467						6 467	1 039	874	1 912	8 380
2	Products of industry	889	111 350	626	2 749	62	248	115 925	48 544	24 269	72 812	188 737
3	Construction work	140	1 132	27 356	429	36	67	29 161	217	143	360	29 521
4	Trade, hotel, transport services	150	3 375	399	79 355	447	439	84 164	2 044	1 512	3 557	87 721
5	Private services	13	1 428	211	1 953	66 939	416	70 961	3 580	1 493	5 073	76 033
6	Other services	4	58	5	200	2	55 843	56 112	559	281	840	56 952
7	Total	7 663	117 344	28 597	84 686	67 486	57 013	362 790	55 983	28 571	84 554	447 344
8	CIF/FOB adjustments on imports								- 133	- 30	- 163	- 163
9	Direct purchases abroad by residents								4 997	3 160	8 157	8 157
10	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790	60 847	31 701	92 548	455 338

Use table at basic prices

No	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES (NACE)							FINAL USES									
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exportsextra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	1 544	3 762	26	392	9	84	5 817	1 554		176	103		240	381	108	2 562	8 380
2	Products of industry	1 258	49 687	7 623	11 201	3 005	5 732	78 506	26 456		848	16 483	153	685	40 331	25 276	110 231	188 737
3	Construction work	99	542	1 993	951	3 598	1 308	8 492	868			19 453			429	280	21 030	29 521
4	Trade, hotel, transport services	563	9 978	1 837	13 439	1 754	2 400	29 971	42 586		1 295	4 758	1	108	5 415	3 589	57 752	87 723
5	Private services	165	7 327	1 721	10 377	21 498	4 342	45 430	20 921		195	3 553		- 24	3 610	2 347	30 601	76 032
6	Other services	102	1 310	76	801	1 620	3 014	6 922	8 591	3 670	37 185	251	55		187	90	50 030	56 952
7	Total at basic prices	3 731	72 606	13 276	37 161	31 484	16 880	175 138	100 975	3 670	39 699	44 600	209	1 009	50 353	31 690	272 206	447 344
8	Taxes less subsidies on products	106	202	169	747	737	1 552	3 514	16 299		98	3 071	15		- 218	- 79	19 186	22 699
9	Cif/ fob adjustments on exports														- 133	- 30	- 163	- 163
10	Direct purchases abroad by residents								8 157								8 157	8 157
11	Domestic purchases. by non-residents								- 12 360						9 528	2 832		
12	Total at purchasers' prices	3 837	72 808	13 445	37 907	32 221	18 433	178 652	113 071	3 670	39 797	47 672	224	1 009	59 530	34 413	299 386	478 037
13	Compensation of employees	504	25 517	8 298	26 129	14 458	32 269	107 174										
14	Other net taxes on production	- 906	908	345	981	883	810	3 021										
15	Consumption of fixed capital	1 520	6 407	1 007	6 634	9 363	4 642	29 574										
16	Operating surplus, net	2 709	11 705	5 501	13 036	10 561	859	44 370										
17	Value added at basic prices	3 826	44 536	15 152	46 779	35 265	38 580	184 138										
18	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790										

Production approach		Income approach		Expenditure approach	
Total output at basic prices	362 790	Compensations of employees	107 174	Household final consumption expenditure	113 071
- Intermediate consumption at basic prices	-175 138	+ Other net taxes on production	3 021	+ NPISH final consumption expenditure	3 670
- Taxes less subsidies on products	-3 514	+ Capital consumption	29 574	+ Government consumption expenditure	39 797
		+ Net operating surplus	44 370	+ Gross fixed capital formation	47 672
				+ Changes in inventories	224
= Value added at basic prices	184 138	= Value added at basic prices	184 138	+ Acquisitions less disposals of valuables	1 009
				+ Exports of goods and services	93 943
+ Taxes less subsidies on products	22 699	+ Taxes less subsidies on products	22 699	- Imports of goods and services	-92 548
= Gross domestic product	206 837	= Gross domestic product	206 837	= Gross domestic product	206 837

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The use table is separated into a use table for domestic production and a use table for imports. The statistical requirements for such a separation are demanding, but the results allow considerable flexibility in the treatment of imports and permit a clear analysis of the impact of demand on supplies from resident producers and on foreign supplies. It should be noted that the total difference between CIF and FOB values in line 9 of Table 11.2 is not the total difference between CIF and FOB values, but only that part which is supplied from domestic producers.

Table 11.2: Use tables for domestic production and imports

No	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE): Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	FINAL USES: Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Use table for domestic output at basic prices																	
1	Products of agriculture	1 345	2 737	19	366	9	80	4 557	925		176	90		231	381	108	1 911	6 467
2	Products of industry	856	19 534	4 405	6 853	2 327	3 630	37 604	11 892	- 749	848	5 119	78	516	37 872	22 743	78 320	115 924
3	Construction work	99	542	1 633	951	3 598	1 308	8 131	868			19 453			429	280	21 030	29 161
4	Trade, hotel, transport services	558	9 484	1 812	10 558	1 712	2 331	26 455	42 564	- 1	1 295	4 751	1	108	5 408	3 585	57 711	84 166
5	Private services	155	6 722	1 569	9 424	18 823	4 001	40 695	20 921		195	3 215		- 24	3 610	2 347	30 264	70 959
6	Other services	102	785	76	791	1 525	2 831	6 109	8 591	3 670	37 185	251	29		187	90	50 003	56 112
7	Total at basic prices	3 115	39 805	9 514	28 942	27 993	14 181	123 551	85 761	2 920	39 699	32 879	108	832	47 887	29 153	239 238	362 790
8	Imported products, cif	616	32 801	3 762	8 218	3 491	2 699	51 587	15 214	750		11 722	101	178	2 466	2 537	32 968	84 554
9	Net taxes on products	106	202	169	747	737	1 552	3 514	16 299		98	3 071	15		- 218	- 79	19 186	22 699
10	Cif/ fob adjustments														- 133	- 30	- 163	- 163
11	Dir. purch.abroad res.								8 157								8 157	8 157
12	Dom. purch. by non-res.								- 12 360						9 528	2 832		
13	Total at purchasers' prices	3 837	72 808	13 445	37 907	32 221	18 433	178 652	113 071	3 670	39 797	47 672	224	1 009	59 530	34 413	299 386	478 037
14	Comp. of employees	504	25 517	8 298	26 129	14 458	32 269	107 174										
15	O. net taxes production	- 906	908	345	981	883	810	3 021										
16	Cons. of fixed capital	1 520	6 407	1 007	6 634	9 363	4 642	29 574										
17	Operating surplus, net	2 709	11 705	5 501	13 036	10 561	859	44 370										
18	Value added at basic prices	3 826	44 536	15 152	46 779	35 265	38 580	184 138										
19	Output at basic prices	7 663	117 344	28 597	84 686	67 486	57 013	362 790										
	Use table for imports at basic prices																	
1	Products of agriculture	199	1 025	7	26	1	4	1 261	629			14		9			652	1 912
2	Products of industry	402	30 153	3 218	4 348	678	2 102	40 902	14 563	749		11 363	74	169	2 459	2 533	31 911	72 812
3	Construction work			360				360										360
4	Trade, hotel, transport services	5	493	25	2 882	42	69	3 516	22	1		7			7	4	41	3 557
5	Private services	10	605	152	953	2 675	341	4 735				338					338	5 073
6	Other services		526		10	95	183	813					27				27	840
7	Total at basic prices	616	32 801	3 762	8 218	3 491	2 699	51 587	15 214	750		11 722	101	178	2 466	2 537	32 968	84 554

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11.2.2 Product-by-product versus industry-by-industry tables

The intermediate part of a symmetric input-output table (SIOT) is *square*: the number of rows is equal to the number of columns. The dimension can be either product-by-product or industry-by-industry. The fact that symmetric input-output tables are square is important for input-output analysis. There are many ways of using symmetric input-output tables in analysis. Well-known examples are productivity analysis, energy analysis and environmental analysis. For any type of analysis in which product relations in the interdependent production process or inter-industry relations play a role, symmetric input-output tables can be a very useful tool.

A product-by-product input-output table (Table 11.3) describes the technological relations between products and homogeneous units of production (branches). The intermediate part describes, for each product, the amounts of products that were used to produce this product, irrespective of the producing industry. In other words, it is assumed the the products of agriculture were only produced by production units of the homogeneous branch agriculture. An industry-by-industry table describes inter-industry relations. The intermediate part of the table describes for each industry the use of products in production.

Product-by-product input-output tables are *theoretically* more homogeneous in their description of the transactions than industry-by-industry tables, since a single element of the latter can refer to products that are charactericstic in other industries. This supports the assumption that *in practice* product-by-product tables generally are better suited for many types of input-output analysis. This is the main reason for ESA 1995 to favour product-by-product tables for economic analysis. The transmission programme of ESA 1995 requires Member States of the European Union to transmit product-by-product tables. However, the transmission of industry-by-industry input-output tables is also accepted provided that industry-by-industry tables are a good approximation of product-by-product input-output tables.

While product-by-product input-output tables are believed to be more homogeneous, industry-by-industry input-output tables are closer to statistical sources and actual observations. In empirical research it depends on the objectives of analysis which type of input-output table is better suited for economic analysis. For example, it seems more feasible to use product-by-product input-output tables for productivity analysis or the analysis of new technologies in the economy. On the other hand, industry-by-industry input-output tables are possibly the better option if the economic impact of a major tax reform is studied on the basis of input-output data. Insofar, annual supply and use tables at basic prices provide the user with flexible access to input-output data for various applications. This chapter will focus on the compilation of both types of tables.

Table 11.3: Symmetric input-output table at basic prices (product by product)

Current and constat prices

No	HOMOGENEOUS BRANCHES / PRODUCTS (CPA)	HOMOGENEOUS BRANCHES: Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	FINAL USES: Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	Intermediate consumption at basic prices							Final demand at basic prices									
2	Products of industry																	
3	Construction work																	
4	Trade, hotel, transport services																	
5	Private services																	
6	Other services																	
7	Total at basic prices																	
8	Direct purchases abroad by residents																	
9	Purchases on the domestic territory by non-residents																	
10	Taxes les subsidies on products																	
11	Total at purchasers' prices																	
12	Compensation of employees	Value added at basic prices																
13	Other net taxes on production																	
14	Consumption of fixed capital																	
15	Operating surplus, net																	
16	Value added at basic prices																	
17	Output at basic prices																	
18	Imports CIF intra EU	Imports CIF																
19	Imports CIF extra EU																	
20	Imports CIF																	
21	Supply at basic prices																	

= empty

Table 9.12 of ESA 1995 shows a symmetric input-output table of the dimension product-by-product. The valuation chosen for the symmetric input-output table is basic prices. Table 11.3 corresponds to the promoted concept of product-by-product input-output tables. The first quadrant of the table shows the intermediate consumption of products used in the production process of each product. The second quadrant shows the final uses of products in the economy. These rows show the use of products without differentiating whether domestic or imported products are used.

Valuation at basic prices means that the use of trade and transport margins are shown explicitly in the product rows for trade and transport services, rather than implicitly in the purchase of products. The amounts of taxes and subsidies paid on products are as well separately shown in row 10 of Table 11.3, both for intermediate and for final uses. In rows (12) to (15), the components of value added are distributed over the production processes of the products in which the value added is actually generated.

The sum for each column at this stage is equal to output at basic prices for each product. By adding the imports of each product in rows (18) to (20) to domestic output of the corresponding product total supply for each product is obtained. The transposed vector for total imports in the input-output table 11.3 in row (20) is equivalent with the vector of the input-output table of imports 11.5 in column (17). Then, the total for each row of the symmetric input-output table for total supply will be equal to the total of the corresponding row for total uses.

Note that the rows (18) to (20) for imports have nothing to do with the inputs used in the production processes of the products in rows (1) to (6). Imports of similar products are merely added from the import matrix to the domestic output of products to balance supply of each product with the use of each product. An alternative registration would be to include imports in Table 11.3 as negative column vectors among final uses. The row and column totals would then amount to the domestic output of each product.

Table 11.4: Symmetric input-output table for domestic output at basic prices (product-by-product)

	HOMOGENEOUS BRANCHES / PRODUCTS (CPA)	HOMOGENEOUS BRANCHES							FINAL USES									Total use at purchasers' prices
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exportsextra EU FOB	Total	
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	Intermediate consumption of domestic products at basic prices							Final demand of domestic products at basic prices									
2	Products of industry																	
3	Construction work																	
4	Trade, hotel, transport services																	
5	Private services																	
6	Other services																	
7	Total at basic prices																	
8	Use of imported products, CIF	Intermediate consumption of imported products at basic prices							Final demand of imported products at basic prices									
9	Direct purchases abroad by residents																	
10	Purchases on the domestic territory by non-residents																	
11	Taxes les subsidies on products	Taxes less subsidies on products							Taxes less subsidies on products									
12	Total at purchasers' prices																	
13	Compensation of employees	Value added at basic prices																
14	Other net taxes on production																	
15	Consumption of fixed capital																	
16	Operating surplus, net																	
17	Value added at basic prices																	
18	Output at basic prices																	

= empty

Table 11.5: Symmetric input-output table for imports at basic prices (product-by-product)

	HOMOGENEOUS BRANCHES / PRODUCTS (CPA)	HOMOGENEOUS BRANCHES							FINAL USES									
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exportsextra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	Intermediate consumption of imported products at basic prices							Final demand of imported products at basic prices									
2	Products of industry																	
3	Construction work																	
4	Trade, hotel, transport services																	
5	Private services																	
6	Other services																	
7	Total at basic prices																	

The corresponding input-output table for domestic output is presented in Table 11.4. The first quadrant (intermediate uses) and the second quadrant (final uses) cover only domestic products. In row 8 of Table 11.5 the total level of imported products is added to the table from the last row of the input-output table for imports in Table 11.6. In this case, the use of imported products reflects the input requirements of the production processes of imported products. The input-output table for domestic output is of particular importance for impact analysis of economic policies on the domestic economy.

In Table 11.5 the general form of a symmetric input-output table for imports at basic prices is presented in a product-by-product classification. The main difference of a use table of imports and an input-output table of imports lies in the classification. While the use table of imports is a product-by-industry table, the input-output table of imports is either a product-by-product table or an industry-by-industry table.

The following input-output tables in Table 11.6 and Table 11.7 are comprised of empirical examples of input-output tables according to the submission programme for the European System of Accounts.

Table 11.6: Input-output table at basic prices

	BRANCHES / PRODUCTS (CPA)	OUTPUT OF HOMOGENEOUS BRANCHES							FINAL USES									
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	1 516	3 909	17	285	9	82	5 817	1 554		176	103		240	381	108	2 562	8 380
2	Products of industry	1 031	50 548	7 836	10 467	3 123	5 500	78 506	26 456		848	16 483	153	685	40 331	25 276	110 231	188 737
3	Construction work	69	466	2 065	864	3 753	1 274	8 492	868			19 453			429	280	21 030	29 521
4	Trade, hotel, transport services	444	9 895	1 820	13 693	1 793	2 325	29 970	42 586		1 295	4 758	1	108	5 414	3 589	57 751	87 721
5	Private services	113	6 808	1 653	10 533	22 110	4 214	45 431	20 921		195	3 553		- 24	3 611	2 348	30 603	76 033
6	Other services	97	1 274	70	774	1 691	3 016	6 922	8 591	3 670	37 185	251	55		187	90	50 030	56 952
7	Total at basic prices	3 271	72 900	13 459	36 617	32 480	16 411	175 138	100 975	3 670	39 699	44 600	209	1 009	50 353	31 690	272 206	447 344
8	Net taxes on products	86	189	170	768	757	1 542	3 513	16 299		98	3 071	15		- 218	- 79	19 186	22 699
9	Dir. purch. abroad resid.								8 157								8 157	8 157
10	Dom. purch. by non-resid.								- 12 360						9 528	2 832		
11	Total at purch. prices	3 357	73 090	13 630	37 385	33 238	17 953	178 652	113 071	3 670	39 797	47 672	224	1 009	59 663	34 443	299 549	478 200
12	Comp. of employees	327	24 706	8 621	26 253	15 245	32 022	107 174										
13	O. net taxes production	- 746	689	347	1 020	921	790	3 021										
14	Cons. of fixed capital	1 250	6 469	971	6 202	10 136	4 545	29 574										
15	Operating surplus, net	2 280	10 970	5 592	13 305	11 421	802	44 370										
16	Value added at basic prices	3 110	42 835	15 531	46 779	37 723	38 159	184 138										
17	Output at basic prices	6 467	115 925	29 161	84 164	70 961	56 112	362 790										
18	Imports CIF intra EU	1 039	48 544	217	2 044	3 580	559	55 983										
19	Imports CIF extra EU	874	24 269	143	1 512	1 493	281	28 571										
20	Imports CIF	1 912	72 812	360	3 557	5 073	840	84 554										
21	Supply at basic prices	8 380	188 737	29 521	87 721	76 033	56 952	447 344										

Production approach		**Income approach**		**Expenditure approach**	
Total output at basic prices	362 790	Compensations of employees	107 174	Household final consumption expenditure	113 071
- Intermediate consumption	-175 138	+ Other net taxes on production	3 021	+ NPISH final consumption expenditure	3 670
- Taxes less subsidies on products	-3 513	+ Capital consumption	29 574	+ Government consumption expenditure	39 797
		+ Net operating surplus	44 370	+ Gross fixed capital formation	47 672
				+ Changes in inventories	224
= Value added at basic prices	184 138	= Value added at basic prices	184 138	+ Acquisitions less disposals of valuables	1 009
				+ Exports of goods and services	94 106
+ Taxes less subsidies on products	22 699	+ Taxes less subsidies on products	22 699	- Imports of goods and services	-84 554
				- Direct purchases abroad by residents	-8 157
= Gross domestic product	206 837	= Gross domestic product	206 837	= Gross domestic product	206 837

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In the input-output tables of the transmission programme for ESA 1995 'Direct purchases abroad by residents' and 'Purchases on the domestic territory by non-residents' are not reported as this information is not required for input-output models. However, to reflect all information of the supply and use tables also in the input-output tables these two rows are also reported in the input-output tables of the manual.

Table 11.7: Input-output tables for domestic output and for imports at basic prices

	BRANCHES / PRODUCTS (CPA)	OUTPUT OF HOMOGENEOUS BRANCHES							FINAL USES									
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Input-output table for domestic output at basic prices																	
1	Products of agriculture	1 324	2 864	14	270	8	77	4 557	925		176	90		231	381	108	1 911	6 467
2	Products of industry	714	19 938	4 547	6 521	2 423	3 461	37 604	11 892		99	5 119	78	516	37 872	22 743	78 320	115 925
3	Construction work	69	466	1 704	864	3 753	1 274	8 131	868			19 453			429	280	21 030	29 161
4	Trade, hotel, transport services	441	9 429	1 800	10 763	1 757	2 265	26 455	42 564		1 294	4 751	1	108	5 407	3 584	57 710	84 164
5	Private services	107	6 258	1 510	9 574	19 355	3 892	40 696	20 921		195	3 215		- 24	3 611	2 348	30 265	70 961
6	Other services	97	745	70	765	1 590	2 843	6 109	8 591	3 670	37 185	251	29		187	90	50 003	56 112
7	Total at basic prices	2 752	39 700	9 645	28 756	28 887	13 811	123 552	85 761	3 670	38 949	32 879	108	832	47 887	29 153	239 238	362 790
8	Imported products, CIF	519	33 200	3 815	7 861	3 593	2 599	51 587	15 214		750	11 722	101	178	2 466	2 537	32 968	84 554
9	Net taxes on products	86	189	170	768	757	1 542	3 513	16 299		98	3 071	15		- 218	- 79	19 186	22 699
10	Dir. purch.abroad res.								8 157								8 157	8 157
11	Dom. purch. by non-res.								- 12 360						9 528	2 832		
12	Total at purch. prices	3 357	73 090	13 630	37 385	33 238	17 953	178 652	113 071	3 670	39 797	47 672	224	1 009	59 663	34 443	299 549	478 200
13	Comp. of employees	327	24 706	8 621	26 253	15 245	32 022	107 174										
14	O. net taxes production	- 746	689	347	1 020	921	790	3 021										
15	Cons. of fixed capital	1 250	6 469	971	6 202	10 136	4 545	29 574										
16	Operating surplus, net	2 280	10 970	5 592	13 305	11 421	802	44 370										
17	Value added at basic prices	3 110	42 835	15 531	46 779	37 723	38 159	184 138										
18	Output at basic prices	6 467	115 925	29 161	84 164	70 961	56 112	362 790										
	Input-output table for imports at basic prices																	
1	Products of agriculture	192	1 045	4	15	1	4	1 261	629			14		9			652	1 912
2	Products of industry	317	30 610	3 288	3 946	700	2 040	40 902	14 563		749	11 363	74	169	2 459	2 533	31 911	72 812
3	Construction work			360				360										360
4	Trade, hotel, transport services	3	466	20	2 930	36	60	3 516	22		1	7			7	4	41	3 557
5	Private services	6	550	142	959	2 755	322	4 735				338					338	5 073
6	Other services		529		10	101	173	813					27				27	840
7	Total at basic prices	519	33 200	3 815	7 861	3 593	2 599	51 587	15 214		750	11 722	101	178	2 466	2 537	32 968	84 554
8	Dir. purch. abroad res.														4 997	3 160	8 157	8 157
9	Total	519	33 200	3 815	7 861	3 593	2 599	51 587	15 214		750	11 722	101	178	7 463	5 697	41 125	92 711

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11.2.3 Statistical units underlying symmetric input-output tables and supply and use tables

The supply and use tables are based on the use of the local kind-of-activity units (local KAU) as unit of observation. The local KAU is designed to partition institutional units into smaller and more homogeneous units with regard to the kind of production.

> *In order to analyse flows occurring in the process of production and in the use of goods and services, it is necessary to choose units which emphasise relationships of a technical-economic kind. This requirement means that as a rule institutional units must be partitioned into smaller more homogeneous units with regard to the kind of production. Local kind-of-activity units are intended to meet this requirement as a first but practice-oriented operational approach. (ESA 1995, p. 2.105)*

If an institutional unit consists of a principal activity and also one or several secondary activities, it should be subdivided into the same number of KAUs. However, "KAUs falling within a particular heading of the classification system can produce products outside the homogeneous group on account of secondary activities connected with them which cannot be separately identified from available accounting documents. Thus a KAU may carry out one or more secondary activities." (ESA 1995, p. 2.107)

These quotations from the ESA make clear that even if local KAUs are designed to describe production processes as homogeneously as possible, in practice it is impossible to observe the data necessary to describe each process separately. If observation were perfect, the local KAU would be a perfectly homogeneous unit without secondary production, apart from possible by- and joint products (see below for definitions).

The main purpose of product-by-product symmetric input-output tables is to describe technological relations in an economy in a way that can be used for input-output analysis. For input-output analysis, tables are required that describe production processes as homogeneously as possible. The product-by-product tables are therefore based on the so-called unit of homogeneous branches. This is a more analytical construct (i.e. not existing in reality) where secondary production (apart from possible by- or joint production), by definition, does not exist (see ESA 1995, p. 2.111-2.118). An industry-by-industry table on the other hand should use the local KAU as basic unit.

Although ESA 1995 requires the use of the local KAU for the supply and use tables, in practice in many countries only data from enterprises (institutional units) are available. In this situation the amount of secondary production in the supply and use tables will be higher than in the case when more homogeneous local KAUs could have been distinguished. There is also an impact on the recording of the intra-enterprise flows. In principle flows between local KAUs belonging to the same enterprise should be recorded in the supply and use tables. However if only enterprise data are available these flows remain unobserved.

The more secondary production is reported in the supply and use tables, the larger the difference between product-by-product tables and industry-by-industry tables becomes. The latter will become more heterogeneous. In the same way, in countries where observation is very close to the local KAU level, there will be very little secondary output reported in the supply table and hence the distinction between products and industries fades away.

Thus, in some countries the product-by-product table can be approximated by an industry-by-industry table, but only when observation of units is at a detailed local KAU level. If the supply and use tables are compiled with enterprises as basic unit, industry-by-industry tables easily become very heterogeneous. In the supply and use tables the CPA and NACE classifications are used for the distribution of output etc. over products and industries, respectively. These classifications were not designed specifically for input-output analysis. The criteria used to distinguish products and industries are developed to satisfy a variety of purposes. For input-output analysis, the similarity of input structures is an important criterion, but it is only one of the criteria used in CPA and NACE. Hence, there are instances where the classifications of supply and use tables conflict with the requirements of input-output analysis, in the sense that heterogeneity is increased.

11.2.4 Types of secondary production

In this chapter we will distinguish between three types of secondary production:

- subsidiary products: those secondary products that are technologically unrelated to the primary product;
- by-products: products that are produced simultaneously with another product, but which can be regarded as secondary to that product (e.g. gas by blast furnaces);
- joint products: products that are produced simultaneously with another product, but which cannot be said to be secondary (e.g. beef and hide).

In practice there will be few cases of "pure" subsidiary, by- or joint production. In most cases there will be some joint costs and some costs that can be attributed to the distinctive outputs.

Table 11.8: Share of secondary product output in total output of industries

No	Code	Country	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	BE	Belgium	15.5	-	16.2	-	16.7	11.9	14.7	15.2	-
2	BG	Bulgaria	-	-	-	-	-	-	-	-	-
3	CZ	Czech Republic	19.0	12.7	11.6	10.9	10.5	10.6	11.3	9.4	8.6
4	DK	Denmark	3.2	3.5	3.4	3.4	3.3	3.3	-	-	-
5	DE	Germany	5.8	-	5.5	5.6	5.6	5.4	5.4	5.4	-
6	EE	Estonia	-	-	11.0	-	-	7.5	7.8	7.9	-
7	IE	Ireland	-	-	-	1.2	-	6.1	-	-	-
8	GR	Greece	1.7	1.8	1.7	1.8	1.7	-	-	-	-
9	ES	Spain	4.8	4.7	4.6	4.6	4.6	4.9	-	-	-
10	FR	France	1.8	-	1.9	-	1.9	1.9	1.8	-	-
11	IT	Italy	7.6	7.9	8.0	8.2	8.4	8.6	8.5	8.1	8.1
12	CY	Cyprus	-	-	-	-	-	-	-	-	-
13	LV	Latvia	-	6.4	-	6.5	-	-	-	-	-
14	LT	Lithuania	-	-	-	-	-	9.6	8.9	9.9	8.9
15	LU	Luxembourg	3.5	3.6	4.0	3.7	3.5	3.4	3.8	3.6	3.1
16	HU	Hungary	-	-	-	8.9	10.6	11.4	11.1	11.4	12.0
17	MT	Malta	-	-	-	-	-	5.8	5.7	-	-
18	NL	Netherlands	11.7	11.8	11.9	12.0	12.0	11.9	11.6	-	11.8
19	AT	Austria	7.0	-	6.6	-	6.5	6.7	6.7	6.8	7.0
20	PL	Poland	-	-	-	-	-	12.2	-	-	-
21	PT	Portugal	2.4	2.6	2.5	2.7	2.8	5.7	5.7	5.7	-
22	RO	Romania	-	-	-	-	-	-	-	-	-
23	SI	Slovenia	-	12.1	-	-	-	13.3	13.1	13.3	-
24	SK	Slovakia	18.2	15.4	13.4	13.3	13.2	16.5	-	13.6	-
25	FI	Finland	7.5	7.6	7.6	7.5	7.8	5.9	5.5	5.2	6.3
26	SE	Sweden	6.9	6.9	7.5	7.7	7.9	7.9	7.8	-	-
27	UK	United Kingdom	6.2	6.0	5.7	5.9	6.1	6.1	6.0	5.8	5.5
28	EU	European Union	6.1	6.9	6.0	6.5	6.2	6.3	6.3	6.8	7.4

Source: Eurostat supply tables

Table 11.8 reports how significant primary and secondary activities are in the European Union at the 60 branch level. The information was derived from the supply tables 1995-2003 which were submitted by the member countries to Eurostat during the data transmission programme for ESA 1995.

For the European Union a relatively low level of secondary activities is reported in the supply tables. During the period 1995-2002 secondary output of industries lies on average between 6 and 7 % of total output. For the year 2000 the lowest level of secondary activities is reported for France (1.9%) and the highest level for Slovakia (16.5%). For a country like France the use table at basic prices is more or less identical with an input-output table either in an industry-by-industry classification or product-by-product classification which is a consequence of the specific French compilation approach. However it must be noticed that secondary activities vary considerably across sectors even if the general level is low. For example in Germany the general level of secondary activities of industries in 2000 is 5.4% while in the industry "Collection, purification and distribution of water" the corresponding level of secondary activities is 30.5 %.

In most European countries the reported level of secondary products of industries as well as the production of products in secondary industries is relatively low. Insofar, the difference between product-by-product input-output tables and industry-by-industry input-output tables is relatively small. Both transformations can be regarded as valid options for impact analysis.

11.3 Theoretical framework for derivation of symmetric input-output tables

The four standard methods to derive symmetric input-output tables from supply and use tables were already set out in the SNA 1968. According to the SNA there are two types of tables: product-by-product tables and industry-by-industry tables. Each can be derived using either the assumption of a product technology (a product has the same input structure in whichever industry it is produced) or the assumption of an industry technology (all products produced by an industry are produced by the same input structure).

These standard methods are also discussed in summary form in the SNA 1993 and the ESA 1995, and in more detail in the UN Handbook of input-output compilation and analysis (United Nations 1999). Valuable contributions were made by Konijn (1994), Thage (2002a), Thage (2005) and Thage and ten Raa (2006).

The terminology first introduced in the SNA 1968 is misleading, when the term "technology" is used also in connection with the construction of symmetric input-output tables of the industry-by-industry type from supply and use tables. Therefore a revised terminology is used in this manual for the basic transformation models which refers to the categories of technology and market shares – the contribution of each industry to the output of a product – as shown in Figure 11.3. The main distinction concerning assumptions is not between two technology assumptions, but between technology assumptions on the one hand, and sales structure assumptions on the other. With this distinction the product-by-product input-output tables are based on technology assumption while the industry-by-industry input-output tables are derived from sales structure assumptions. Thus, the boxes that contain product-by-product tables based on sales structure assumptions and industry-by-industry tables based on technology assumptions become empty.

Seen in the perspective of the standard quality requirements to official statistics, a distinction between strong and weak assumptions can be made. A "technology" assumption is a strong assumption in the sense that it is based on abstract economic theory that often cannot be underpinned by observed statistical data. Sales structure assumptions are weak assumptions as they generally speaking only utilize known sales structures for the actual year. From a statistical point of view the two types of tables (product-by-product and industry-by-industry) thus belong to different approaches. The assumption of fixed industry sales structures should be rejected as an irrelevant rather than as a strong assumption. Also the industry technology assumption is hardly used for the transformation in empirical research. Model A (Product technology assumption) and Model D (Fixed product sales structure assumption) are widely used by statistical offices.

Figure 11.3: Basic transformation models

		Product-by-product input-output table	Industry-by-industry input-output tables
Technology	Product technology	Model A Each product is produced in its own specific way, irrespective of the industry where it is produced. Negative elements may occur	
	Industry technology	Model B Each industry has its own specific way of production, irrespective of its product mix. No negative elements	
Sales structure	Fixed industry sales structure		Model C Each industry has its own specific sales structure, irrespective of its product mix. Negative elements may occur
	Fixed product sales structure		Model D Each product has its own specific sales structure, irrespective of the industry where it is produced. No negative elements

While industry-by-industry input-output tables are close to statistical sources and more heterogenous in terms of input structures, product-by-product input-output tables are believed to be more homogeneous in terms of cost structures. It remains to be seen in empiricial research which type of tables is the better option for comparisons across nations...

Although the formal characteristics of the four tables A - D remain the same as in the SNA, the criteria for the choice of type of table become much more transparent in Table 11.9.

Industry-by-industry tables which are based on the fixed product sales structure (Model D) do not involve any technology assumptions (A and B), and do not require the application of sometimes arbitrary methods to adjust for negatives (A and C). Furthermore, table D retains the links to the national accounts data and basic statistics, and requires fewer resources to compile. It should also be noted that the overall sales share in a row is not an assumption, but actually observed. The assumption only concerns the distribution by individual elements. There is no similar overall observation to rely on in the case of a product technology assumption if specific survey results on the cost structures of industries are not available.

> *From the…theoretical point of view, the product- (commodity) technology model seems to meet the most desirable properties, i.e. the axioms of material balance, financial balance, scale invariance and price invariance. It also appeals to common sense and is found a priori to be more plausible than the industry technology assumption. While the product technology assumption is thus favoured from a theoretical and common sense point of view, it may need some kind of adjustment in practice. The automatic application of this method has often shown results that are unacceptable, insofar as input-output coefficients sometimes appear extremely improbable or even impossible. There are even numerous examples of the method leading to negative coefficients which are clearly non-sensical from an economic point of view. Improbable coefficients may partly be due to errors in measurement and partly to heterogeneity (product-mix) in the industry of which the transferred product is the principal product. Heterogeneity results from working on aggregate data with a high occurrence of non-characteristic products. This might be overcome by making adjustments based on supplementary information or exploiting informed judgement to the fullest extent possible. (SNA 1993, 15.147)*

In the first part of his chapter we will use the simple example of Table 11.9 to explain the basis of the transformation process. The following examples are based on Konijn (Konijn 1994).

Table 11.9: Numerical example of supply and use tables

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	0	80	50	130	130	0	130
Manufacturing products	60	30	130	220	20	200	220
Wages and salaries	60	20	-	80	-	-	
Operating surplus	30	70	-	100	-	-	
Total	150	200	180		150	200	

Agriculture produces 20 units of secondary output of products that are primary to the manufacturing industry. The manufacturing industry has no secondary output.

11.3.1 Product-by-product tables

Product technology assumption

The most frequently discussed method for deriving product-by-product tables is the method based on the product technology assumption:

Each product is produced in its own specific way, irrespective of the industry where it is produced.

It is assumed that there is only one way to produce each product. In other words, each product has its own typical input structure. For each product the same proportions of products and factor inputs are used to produce one unit of the product disregarding in which industry the product is actually produced.

The product technology assumption seems to be the most applicable in cases of subsidiary production, since in those cases the technologies of primary and secondary products are independent. However, the product technology assumption does not exclude cases where two or more products are produced in the same process (i.e. joint production). Only when one of the products is also produced elsewhere *but in a different way*, is the product technology assumption not valid.

When calculating the product-by-product input-output table using the product technology assumption, the secondary products are transferred from the industries where they are produced to the industries of which they are the primary product. In this process, the columns are transformed from referring to industries to referring to products. Note that the product technology model requires that for each product a primary producer is defined. The input structure of the primary producer is the starting point for deriving the input structure of the product.

Table 11.10: Transformation matrix for the product technology assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	-8	8	0	0	0	0	0
Manufacturing products	-3	3	0	0	-20	20	0
Wages and salaries	-2	2	-	0	-	-	-
Operating surplus	-7	7	-	0	-	-	-
Total	-20	20	0		-20	20	

The transformation can be explained by means of transformation matrices that are added to the original tables. In the above example, the transformation matrices on the basis of the product technology assumption are presented in Table 11.10.

In the supply table, the 20 units of secondary output are transferred from the agriculture column to the manufacturing column. The inputs corresponding to the transferred secondary output are determined by the input structure of the manufacturing industry, since this is the primary producer of manufacturing products and the manufacturing industry does not have any secondary production. Hence, (80/200)*20 = 8 units of agricultural products, (30/200)*20 = 3 units of manufacturing products, (20/200)*20 = 2 units of wages and salaries and (70/200)*20 = 7 units of operating surplus are transferred.

When the transformation tables are added to the original tables, we obtain:

Table 11.11: Supply and use tables based on product technology assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	- 8	88	50	130	130	0	130
Manufacturing products	57	33	130	220	0	220	220
Wages and salaries	58	22	-	80	-	-	
Operating surplus	23	77	-	100	-	-	
Total	130	220			130	220	

Notice that the supply table has become diagonal, and that the column sums of supply and use tables are now both equal to total output per product. The columns now describe input structures of products. Hence, the transformed use table is the sought-after product-by-product input-output table. Final demand is not affected since this is already formulated in terms of products. For a mathematical formulation of the procedure see Table 11.27.

The example immediately shows the main drawback of the product technology model: it may give rise to negative elements. We will come back to the issue of negatives later. The mathematical terms of the various transformation models will be described in a special subchapter.

Simplified, the model can be formulated as the following matrix multiplication:

*Use table = IO coefficient matrix * Supply table*

In this case the use and supply tables exclude the final demand and imports columns. The matrix of input coefficient was derived from the symmetric input-output table by dividing the columns by their totals with -0.0615 = -8/130, etc. These coefficients show how much of one product is required to produce one unit of another product. The supply table of course shows how much of each product is produced by each industry. The formula says that if, for a particular industry, one multiplies the amount produced of each product with the input structures of those products as given by the input coefficient matrix, the result should be the column of the use table relating to that industry. The results are presented in Table 11.12.

Table 11.12: Transformation model for the product technology assumption

	Use table			Input coefficients			SUPPLY TABLE	
	Agriculture	Manufacturing		Agriculture	Manufacturing		Agriculture	Manufacturing
Agricultural products	0	80	=	- 0.0615	0.4000	*	130	0
Manufacturing products	60	30		0.4385	0.1500		20	200
Wages and salaries	60	20		0.4462	0.1000			
Operating surplus	30	70		0.1769	0.3500			

Industry technology assumption

The industry technology assumption can be formulated as follows:

Each industry has its own specific way of production, irrespective of its product mix.

In other words: each industry has its own input structure. To each industry we can attach a column of input coefficients that are typical of that industry. Even if the output mix of an industry changes, the proportions in which the inputs are used are not affected. The industry technology applies best to cases of by- or joint production, since in those cases several products are produced in a single production process.

Again, the application of the assumption can be explained by a transformation process. In this case, the transformation matrices for the example would be:

Table 11.13: Transformation matrix for the industry technology assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	0	0	0	0	0	0	0
Manufacturing products	-8	8	0	0	-20	20	0
Wages and salaries	-8	8	-	0	-	-	-
Operating surplus	-4	4	-	0	-	-	-
Total	-20	20	0		-20	20	

The secondary output of the agricultural industry (20) and the corresponding inputs are transferred to the column of the manufacturing industry. The corresponding inputs are determined by the input structure of agriculture: (60/150)*20 = 8 units of manufacturing products, (60/150)*20 = 8 units for wages and salaries and (30/150)*20 = 4 units of operating surplus.

The resulting supply and use tables based on the industry technology assumption are presented in Table 11.14.

Table 11.14: Supply and use tables based on the industry technology assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	0	80	50	130	130	0	130
Manufacturing products	52	38	130	220	0	220	220
Wages and salaries	52	28	-	80	-	-	
Operating surplus	26	74	-	100	-	-	
Total	130	220			130	220	

In this case, negatives cannot arise since the amounts transferred are never larger than the amounts available in the columns of the industries. However, avoiding negatives does not imply that the results are therefore more plausible. The method is formulated mathematically in Table 11.27.

Note that the column for manufacturing products contains a mix of two input structures: those of manufacturing products as produced as a primary product by manufacturing and the input structure of manufacturing products as produced by agriculture as a secondary product.

In input-output analysis, coefficient matrices are derived from the symmetric input-output tables by dividing the inputs by the column totals. These coefficient matrices are then assumed to be fixed in the impact analysis. Since the columns of these matrices which were derived with the industry technology assumption contain a mix of input structures, the coefficients can remain fixed only if the proportions in which the input structures are used remain fixed as well. In other words, if the demand for the manufacturing products would increase, then the inputs required to satisfy this demand can be calculated by the coefficient matrices only if the market shares of the two producing industries remain constant. Thus, input-output analysis with a product-by-product table based on the industry technology assumption implicitly requires the assumption of fixed market shares.

Mixed technology assumptions

We have seen that the product technology assumption is most suitable in cases of subsidiary production, while the industry technology assumption applies best to cases of by-production or joint production. In reality, of course, there will be cases of all types of secondary production.

Box 11.1: Hybrid technology assumption

In this example it is demonstrated how a product-by-product input-output table may be compiled with the hybrid technology model.

The product technology assumption is most suitable for subsidiary production while the industry technology assumption applies best to cases of by- or joint production. In reality, there will be cases of all types of secondary production. It is possible to use a mix of product and industry technology assumptions. The classical way of doing this to divide the supply table in two parts: one which contains the primary and subsidiary products, and another which contains the by- or joint products. The product technology is applied to the first part, the industry technology to the second. This is called a "mixed" or "hybrid" techno-logy model.

SCENARIO A: Product technology

Supply table

	Industry A	Industry B	Industry C	Total
Product A	90	5	15	110
Product B	70	180	50	300
Product C	50	45	155	250
Total	210	230	220	660

Use table

	Industry A	Industry B	Industry C	Final dem.	Output
Product A	10	60	5	35	110
Product B	40	60	20	180	300
Product C	20	30	60	140	250
Value added	140	80	135	0	355
Input	210	230	220	355	

Transposed supply table (make matrix)

	Product A	Product B	Product C	Total
Industry A	90	70	50	210
Industry B	5	180	45	230
Industry C	15	50	155	220
Total	110	300	250	660

Matrix for hybrid technology

	Product A	Product B	Product C
Industry A	1	1	1
Industry B	1	1	1
Industry C	1	1	1

SCENARIO B: Hybrid technology

Supply table

	Industry A	Industry B	Industry C	Total
Product A	90	5	15	110
Product B	70	180	50	300
Product C	50	45	155	250
Total	210	230	220	660

Use table

	Industry A	Industry B	Industry C	Final dem.	Output
Product A	10	60	5	35	110
Product B	40	60	20	180	300
Product C	20	30	60	140	250
Value added	140	80	135	0	355
Input	210	230	220	355	

Transposed supply table (make matrix)

	Product A	Product B	Product C	Total
Industry A	90	70	50	210
Industry B	5	180	45	230
Industry C	15	50	155	220
Total	110	300	250	660

Matrix for hybrid technology

	Product A	Product B	Product C
Industry A	1	0	0
Industry B	1	1	0
Industry C	1	1	1

Make matrix for product technology

	Product A	Product B	Product C	Total
Industry A	90	70	50	210
Industry B	5	180	45	230
Industry C	15	50	155	220
Total	110	300	250	660

Make matrix for product technology

	Product A	Product B	Product C	Total
Industry A	90	0	0	90
Industry B	5	180	0	185
Industry C	15	50	155	220
Total	110	230	155	495

Make matrix for industry technology

	Product A	Product B	Product C	Total
Industry A	0	0	0	0
Industry B	0	0	0	0
Industry C	0	0	0	0
Total	0	0	0	0

Make matrix for industry technology

	Product A	Product B	Product C	Total
Industry A	0	70	50	120
Industry B	0	0	45	45
Industry C	0	0	0	0
Total	0	70	95	165

Input-output table with product technology

	Product A	Product B	Product C	Final dem.	Output
Product A	-13.82	106.29	-17.47	35.00	110.00
Product B	20.60	98.03	1.38	180.00	300.00
Product C	-4.47	22.85	91.61	140.00	250.00
Value added	107.69	72.83	174.48	0.00	355.00
Input	110.00	300.00	250.00	355.00	

Input-output table with hybrid technology

	Product A	Product B	Product C	Final dem.	Output
Product A	5.24	64.70	5.07	35.00	110.00
Product B	20.95	73.78	25.26	180.00	300.00
Product C	10.48	36.89	62.63	140.00	250.00
Value added	73.33	124.63	157.04	0.00	355.00
Input	110.00	300.00	250.00	355.00	

Formulas for hybrid model in Table 11.27

It is possible to use a mix of product and industry technology assumptions. The classical way of doing this was already described by the SNA 1968. In this case the supply table is divided into two parts: one which contains the primary and subsidiary products and another which contains the by- or joint products. The product technology is applied to the first part, the industry technology to the second. This is called a “mixed” or “hybrid” technology model. The model gives no new theoretical viewpoints, but is merely a combination of techniques. An example is given in Box 11.1

11.3.2 Industry-by-industry tables

Industry-by-industry input-output tables can be derived by transferring inputs and outputs over the rows. The product classification of the rows is transformed into the industry classification of the columns. The SNA 1968 introduced for this purpose “industry-by-industry variants” of the product technology and industry technology assumptions. This section will show that this terminology is not correct. A new terminology will be introduced for the same procedures.

Assumption of fixed industry sales structures

The first assumption necessary to derive an industry-by-industry table is the assumption of fixed industry sales structures:

Each industry has its own specific sales structure, irrespective of its product mix

On the basis of this assumption we arrive at the following transformation matrices:

Table 11.15: Transformation matrix for the fixed industry sales structure assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	0.00	12.31	7.69	20.00	20.00	0.00	20.00
Manufacturing products	0.00	-12.31	-7.69	-20.00	-20.00	0.00	-20.00
Wages and salaries	0.00	0.00	-	0.00	-	-	-
Operating surplus	0.00	0.00	-	0.00	-	-	-
Total	0.00	0.00	0.00		0.00	0.00	

The 20 units of secondary output are supposed to be sold in the same proportions to the users as the primary, i.e. the agricultural, output. Thus, 0 units go to agriculture, (80/130)*20 = 12.31 units go to manufacturing and (50/130)*20 = 7.69 units go to final users. This could result in negative elements (for example when there were not any final demand for manufacturing products), but in the example this is not the case. Again, the procedure is described mathematically in Table 11.27.

The resulting tables are presented in Table 11.16.

Table 11.16: Supply and use tables based on the fixed industry sales structure assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	0.00	92.31	57.69	150.00	150.00	0.00	150.00
Manufacturing products	60.00	17.69	122.31	200.00	0.00	200.00	200.00
Wages and salaries	60.00	20.00	-	80.00	-	-	-
Operating surplus	30.00	70.00	-	100.00	-	-	-
Total	150.00	200.00	180.00		150.00	200.00	

This procedure used to be called the "industry-by-industry variant of the product technology assumption". Again, in the derivation here, the product technology assumption has not been used. The assumption of fixed industry sales structures seems to be rather unrealistic. Only in a few cases will firms supply all their products in the same proportions to their users (an example may be secondary trade activities; e.g. software sold together with computers by a computer producing firm). In general it seems more plausible to assume that the secondary products have different destinations than the primary products.

Assumption of fixed product sales structures

A more realistic assumption is that of a fixed product sales structure:

Each product has its own specific sales structure, irrespective of the industry where it is produced.

The term "sales structure" indicates the proportions of the output of a product in which it is sold to the respective intermediate and final users. In the example, the transformation matrices on the basis of this assumption would be:

Table 11.17: Transformation matrix for the fixed product sales structure assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	5.45	2.73	11.82	20.00	20.00	0.00	20.00
Manufacturing products	-5.45	-2.73	-11.82	-20.00	-20.00	0.00	-20.00
Wages and salaries	0.00	0.00	-	0.00	-	-	-
Operating surplus	0.00	0.00	-	0.00	-	-	-
Total	0.00	0.00	0.00		0.00	0.00	

The 20 units of manufacturing products produced by the agricultural industry are assumed to be sold in the same proportions to the industries and final demand as the manufacturing products produced by the manufacturing industry. In the use table, (60/220)*20 = 5.45 units of manufacturing products used by agriculture, (30/220)*20 = 2.73 units used by manufacturing and (130/220)*20 = 11.82 units consumed by final users are transferred.

The resulting industry-by-industry tables are presented in Table 11.18.

Table 11.18: Supply and use tables based on the fixed product sales structure assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	5.45	82.73	61.82	150.00	150.00	0.00	150.00
Manufacturing products	54.55	27.27	118.18	200.00	0.00	200.00	200.00
Wages and salaries	60.00	20.00	-	80.00	-	-	-
Operating surplus	30.00	70.00	-	100.00	-	-	-
Total	150.00	200.00	180.00		150.00	200.00	

Notice that the row sums now equal the industry output levels. The value added is unaffected, since this part is already formulated in terms of industries. For a mathematical formulation see Table 11.27.

This method is known in literature (since SNA 1968) as the "industry-by-industry variant of the industry technology assumption". But in the transformation process as described here no use whatsoever is made of an assumption about technology. The old terminology can perhaps be explained as follows. If the above table were used in input-output analysis, it would be assumed that the output of agriculture and manufacturing is homogeneous. Thus, all products of agriculture are assumed to be produced with the inputs as given by this symmetric input-output table, a kind of industry technology assumption. However, it is a different form of industry technology assumption as the one formulated in the previous section, where it was assumed that all products of agriculture were produced with the inputs as given by the use table.

11.4 Evaluation of the various assumptions; the problem of the negatives

11.4.1 Product technology versus industry technology

Symmetric input-output tables are compiled mainly to be used in input-output analysis. For this reason, the product-by-product variant was preferred by ESA 1995, since this table shows more homogeneous flows than the industry-by-industry variant, which is a requirement for input-output analysis. In using a product-by-product table in input-output analysis, it is assumed that each column of the table represents the input structure of the corresponding product, and that extra demand for that product leads to proportional demand of the products that are input in its production process.

The product technology model, as was shown above, makes basically the same assumptions. The use of the product technology model is therefore fully consistent with the use of product-by-product tables in input-output analysis. This cannot be said of the industry technology assumption that leads to a symmetric input-output table where the columns contain a mix of input structures, requiring the use of the fixed market shares assumption, as shown above.

In practice, most cases of secondary production will be cases of subsidiary production, for which the product technology seems to apply best. Take the example of a construction company that produces some machine repair services as secondary product. The product technology assumption would attempt to estimate the inputs going into the repair services by looking at the typical input structure of repair services when produced e.g. by the repair industry. The industry technology would allocate building materials such as bricks and mortar to the production process of the repair services. If, however, the SNA principle of separating out secondary activities that belong to other tabulation categories in seperate KAUs is acknowledged, such a case will not arise.

Box 11.2: Transformation of supply and use tables to symmetric input-output tables; occurence of negatives

In this example it is demonstrated that Model A and Model C may generate under certain conditions negative transactions. In Scenario B it is assumed that the same final demand of Scenario A is produced by more diversified industries. The primary activities of industries are less intensive and secondary activities are more important. The national value added remains the same in the two scenarios.

Supply and use tables

SCENARIO A

Supply table

	Industry A	Industry B	Industry C	Total
Product A	100	5	5	110
Product B	20	270	10	300
Product C	10	20	220	250
Total	130	295	235	660

Use table

	Industry A	Industry B	Industry C	Final dem.	Output
Product A	6	64	5	35	110
Product B	24	75	21	180	300
Product C	12	34	64	140	250
Value added	88	122	145	0	355
Input	130	295	235	355	1015

SCENARIO B

Supply table

	Industry A	Industry B	Industry C	Total
Product A	90	5	15	110
Product B	70	180	50	300
Product C	50	45	155	250
Total	210	230	220	660

Use table

	Industry A	Industry B	Industry C	Final dem.	Output
Product A	10	60	5	35	110
Product B	40	60	20	180	300
Product C	20	30	60	140	250
Value added	140	80	135	0	355
Input	210	230	220	355	1015

Product-by-product input-output tables

SCENARIO A

Model A: Product technology

	Product A	Product B	Product C	Final dem.	Output
Product A	1.28	70.79	2.93	35.00	110.00
Product B	19.62	80.58	19.80	180.00	300.00
Product C	7.79	31.06	71.15	140.00	250.00
Value added	81.31	117.57	156.12	0.00	355.00
Input	110.00	300.00	250.00	355.00	1015.00

Model B: Industry technology

	Product A	Product B	Product C	Final dem.	Output
Product A	5.81	59.71	9.48	35.00	110.00
Product B	20.18	73.23	26.59	180.00	300.00
Product C	11.17	35.69	63.14	140.00	250.00
Value added	72.85	131.37	150.79	0.00	355.00
Input	110.00	300.00	250.00	355.00	1015.00

SCENARIO B

Model A: Product technology

	Product A	Product B	Product C	Final dem.	Output
Product A	-13.82	106.29	-17.47	35.00	110.00
Product B	20.60	98.03	1.38	180.00	300.00
Product C	-4.47	22.85	91.61	140.00	250.00
Value added	107.69	72.83	174.48	0.00	355.00
Input	110.00	300.00	250.00	355.00	1015.00

Model B: Industry technology

	Product A	Product B	Product C	Final dem.	Output
Product A	5.93	51.43	17.64	35.00	110.00
Product B	19.81	64.84	35.35	180.00	300.00
Product C	13.31	43.78	52.90	140.00	250.00
Value added	70.94	139.96	144.10	0.00	355.00
Input	110.00	300.00	250.00	355.00	1015.00

Industry-by-industry input-output tables

Model C: Fixed industry sales structure

	Industry A	Industry B	Industry C	Final dem.	Output
Industry A	6.97	81.03	4.24	37.76	130.00
Industry B	24.56	67.17	19.13	184.13	295.00
Industry C	10.47	24.80	66.63	133.11	235.00
Value added	88.00	122.00	145.00	0.00	355.00
Input	130.00	295.00	235.00	355.00	1015.00

Model C: Fixed industry sales structure

	Industry A	Industry B	Industry C	Final dem.	Output
Industry A	19.61	140.66	-2.00	51.73	210.00
Industry B	39.64	19.79	1.61	168.96	230.00
Industry C	10.75	-10.45	85.39	134.31	220.00
Value added	140.00	80.00	135.00	0.00	355.00
Input	210.00	230.00	220.00	355.00	1015.00

Model D: Fixed products sale structure

	Industry A	Industry B	Industry C	Final dem.	Output
Industry A	7.53	64.54	8.51	49.42	130.00
Industry B	22.83	73.13	24.25	174.79	295.00
Industry C	11.63	35.33	57.25	130.79	235.00
Value added	88.00	122.00	145.00	0.00	355.00
Input	130.00	295.00	235.00	355.00	1015.00

Model D: Fixed products sale structure

	Industry A	Industry B	Industry C	Final dem.	Output
Industry A	21.52	69.09	20.76	98.64	210.00
Industry B	28.05	44.13	23.03	134.79	230.00
Industry C	20.43	36.78	41.22	121.57	220.00
Value added	140.00	80.00	135.00	0.00	355.00
Input	210.00	230.00	220.00	355.00	1015.00

Formulas for transformation models in Table 11.27

For these reasons, the use of the industry technology formulas should be avoided. However, the product technology assumption is not free of problems either. As shown in the example, it can give implausible results, most notably negative elements in the symmetric input-output tables. The next section elaborates on why these negatives appear.

Industry-by-industry input-output tables have the benefit that they are closer to actual observations and survey results than product-by-product input-output tables. Regarding the choice of methods for industry-by-industry tables the assumption of fixed product sales structures is clearly preferred, due to the unrealistic character of the alternative assumption of fixed industry sales structure. But also for the fixed product sales structure model, it is recommended that as much actual data on inter-industry flows as possible is added to the process. Using this assumption plus additional data, the process of compiling the industry-by-industry table is a relatively straightforward procedure by transforming the supply and use tables to symmetric input-output tables without any further interventions. If the fixed product sales structure is used to compile industry-by-industry input-output tables from supply and use tables, no negative elements can occur in the transformation. However, if the product technology assumption is applied to compile product-by-product input-output tables, it is liely that negative elements will appear. The cause of negatives and the dealing with negative elements is discussed in the next paragraphs.

11.4.2 Causes of negative input-output elements in the product technology

There can be various reasons for the appearance of negative elements:

The product technology assumption can be incorrect

That means that there is a product that is produced in two different ways. Clearly, there are cases where this is true, for example in the chemical industry, where there are often different processes that lead to exactly the same product. Negatives could be created when one process uses inputs that are not used by another.

Economic transactions are recorded rather than technological relations

The supply and use tables record in principle all transactions between local KAUs. These are the *economic* transactions, and do not necessarily describe technology. For example, two companies employ the same process to produce a product. One of the companies subcontracts a large part of the process; the other does the whole process in-house. The two companies will thus show different input structures in the use table, possibly leading to negatives.

Another situation that could lead to negative elements is that of vertically integrated production processes. For example, consider the production of cheese at a dairy farm. The milk produced at the farm and used in the production of cheese is not recorded as input, nor as output, of the dairy farm. Hence, it looks as if the farm produces cheese without using milk. If the cheese were to be transferred to the dairy industry, and the input structure of the dairy industry were to be applied to this cheese, a negative input for milk would appear for the dairy farm.

Non-market output creates a special problem in the application of the product technology assumption. Non-market output is valued by convention as the sum of the costs incurred in its production, with operating surplus fixed at zero. This is applied at the level of the producing unit, not by product. Secondary market products are valued at their market prices, but the value of the total output of the unit is determined by the costs. If therefore the secondary product is transferred to the (market) industry where it is produced as primary product, a negative will arise for the operating surplus.

Heterogeneity in data and classifications

It may also very well be that the negatives are in fact caused by heterogeneity in the data. Heterogeneity is unavoidable because of the simple fact that products and industries need to be aggregated in the supply and use tables. In the example, the manufacturing products produced by agriculture could be totally different products than, or perhaps a subset of, the products produced by the manufacturing industry. It is clear that assuming product technology in such a case creates problems. It is recommended therefore to apply the product technology assumption always at the most detailed level of products possible.

The classifications play an important role here. As mentioned earlier, the international classifications may be based on a variety of criteria that are not always the ones that are appropriate for input-output analysis. An example is footwear. CPA distinguishes footwear of different materials only at the 6-digit level. More important in the CPA is the distinction of footwear by use. However, aggregating leather and plastic shoes in one column of the supply and use tables creates heterogeneity in the description of the production processes. This may lead to negatives when another industry produces one of the two types of shoes as secondary output.

Errors in data

Last but not least, the negatives can be caused by errors in the database of the supply and use tables. This is in fact an important aspect, because it could give insight into the quality of the elements of the supply and use system. In this way, the compilation of the symmetric input-output tables can be a useful tool for checking the plausibility of the data. It could even be envisaged to compile the symmetric input-output tables simultaneously with the supply and use tables so that the results of the symmetric input-output tables can be immediately incorporated back into in the supply and use tables.

11.4.3 Note on the consistency between symmetric input-output tables and supply and use tables

The next section will look at various ways of dealing with the negatives appearing from the application of the product technology assumption. Before that, however, some reflections on the desired result are necessary, in particular on the consistency between the symmetric input-output tables and the supply and use tables. For example, it was said in the previous section that the classifications used in the supply and use tables (NACE and CPA) are not always the most appropriate for input-output analysis. Also, there could be data errors. How can we deal with these issues?

The answer depends on what kind of table we would like to derive. Two extremes can be envisaged. On the one hand, we could aim at a symmetric input-output table that is fully compatible in classifications and values with the supply and use tables. For example, the row totals of the supply and use tables (total product supplies) should be the same as in the symmetric input-output tables. This makes of course the tables much more user-friendly and easy to read, but it restricts the possibilities of dealing with the negatives, as we will see.

On the other hand, we could aim at deriving the best (i.e. the most homogeneous) symmetric input-output tables for input-output analysis. For that, it could be necessary to adapt some classifications or particular accounting conventions. The symmetric input-output tables would not be entirely compatible with the supply and use tables anymore, but input-output analysts might not care about that, since they only use the symmetric input-output tables. In the past, some authors (Rainer and Josef Richter 1992) argued for distinguishing between a "descriptive" set of tables that are a core part of the national accounts, and an "analytical" set which is used by input-output analysts including "analytical" supply and use tables, which differ from the original supply and use tables but are consistent with the symmetric input-output tables.

Thus, there seems to be a trade-off between compatibility in classifications and values and the quality of the symmetric input-output tables. A balance could perhaps be found in requiring compatibility only at the level of aggregation at which the tables are published (e.g. the level of 60 products and industries). Changes to classifications or re-arrangements can then be carried out in as far as it does not change e.g. the values of supply by product at the publication level. Similarly, changes that would affect aggregates such as total output, intermediate consumption, or even GDP, should then be avoided.

There is another dimension to the consistency issue, which is the consistency in the model. It will not be possible to derive a symmetric input-output table that complies exactly with the product technology formula above

*Use table = IO coefficient matrix * Supply table.*

The reason for that is that it will practically not be possible to remove all heterogeneities from the supply and use tables. Perfect homogeneity does not exist. Also, it might not be possible to correct errors in data since the supply and use tables will in most cases already be "closed" for revision. Hence, what we will achieve in practice is

*Use table = IO coefficient matrix * Supply table + Difference matrix*

The difference matrix captures all remaining heterogeneity plus errors in the original data. The size of its elements gives an indication of the quality of the symmetric input-output tables which has been obtained so far. The difference matrix can be obtained by calculating first a "new use" table according to

*New Use table = IO coefficient matrix * Supply table*

and then

Difference matrix = New Use table - Use table.

The difference matrix can therefore be interpreted as those changes that would be necessary to apply to the use table to make it consistent with the supply table and the symmetric input-output table so far obtained.

The only way to obtain a zero difference matrix and thus full consistency in the model is to take the new use table as the definitive use table. That would make the compilation of the symmetric input-output table an integral part of the compilation of the supply and use tables. This is the practice, for example, in Germany.

Box 11.3: Supply and use and the Leontief technology

It is demonstrated that it is impossible to generate negative elements in a product-by-product input-output table with Model A (Product technology assumption) provided that the supply and use tables were established from homogeneous production units with constant input coefficients (Leontief technology).

The structure of the supply table, may it be different as it is, has no impact on the transformation. It is assumed that the same technologies (constant input coefficients) apply in Scenario A and in Scenario B. On the basis of these technologies a common data set is compiled for homogenous units of production.

In Scenario A and Scenario B these homogeneous activities are then distributed to industries with different market shares. The result of the transformation is always the same input-output table of the original data.

SCENARIO A

Input coefficients of homogeneous production units

	Product A	Product B	Product C
Product A	0.10	0.05	0.10
Product B	0.20	0.20	0.30
Product C	0.10	0.10	0.10
Value added	0.60	0.65	0.50
Input	1.00	1.00	1.00

Product-by-product iot with homogeneous production units

	Product A	Product B	Product C	Final dem.	Output
Product A	60	20	50	470	600
Product B	120	80	150	50	400
Product C	60	40	50	350	500
Value added	360	260	250	0	870
Input	600	400	500	870	

Market shares

	Industry A	Industry B	Industry C	Total
Product A	0.80	0.10	0.10	1.00
Product B	0.00	0.90	0.10	1.00
Product C	0.00	0.10	0.90	1.00

Generated supply table

	Industry A	Industry B	Industry C	Output
Product A	376	47	47	470
Product B	0	45	5	50
Product C	0	35	315	350
Input	376	127	367	870

SCENARIO B

Input coefficients of homogeneous production units

	Product A	Product B	Product C
Product A	0.10	0.05	0.10
Product B	0.20	0.20	0.30
Product C	0.10	0.10	0.10
Value added	0.60	0.65	0.50
Input	1.00	1.00	1.00

Product-by-product iot with homogeneous production units

	Product A	Product B	Product C	Final dem.	Output
Product A	60	20	50	470	600
Product B	120	80	150	50	400
Product C	60	40	50	350	500
Value added	360	260	250	0	870
Input	600	400	500	870	

Market shares

	Industry A	Industry B	Industry C	Total
Product A	0.40	0.20	0.40	1.00
Product B	0.30	0.30	0.40	1.00
Product C	0.30	0.50	0.20	1.00

Generated supply table

	Industry A	Industry B	Industry C	Output
Product A	188	94	188	470
Product B	15	15	20	50
Product C	105	175	70	350
Input	308	284	278	870

Generated use table

	Industry A	Industry B	Industry C	Final dem.	Output
Product A	48	29	53	470	600
Product B	96	99	155	50	400
Product C	48	47	55	350	500
Value added	288	295	287	0	870
Input	480	470	550	870	

Generated use table

	Industry A	Industry B	Industry C	Final dem.	Output
Product A	45	43	42	470	600
Product B	117	123	110	50	400
Product C	51	49	50	350	500
Value added	297	275	298	0	870
Input	510	490	500	870	

Input-output table Model A

	Industry A	Industry B	Industry C	Final dem.	Output
Product A	60	20	50	470	600
Product B	120	80	150	50	400
Product C	60	40	50	350	500
Value added	360	260	250	0	870
Input	600	400	500	870	

Input-output table Model A

	Industry A	Industry B	Industry C	Final dem.	Output
Product A	60	20	50	470	600
Product B	120	80	150	50	400
Product C	60	40	50	350	500
Value added	360	260	250	0	870
Input	600	400	500	870	

Formulas for Model A in Table 11.27

11.4.4 Dealing with negatives

There are various ways of dealing with negatives. In this subchapter, we will discuss the options of: merging industries, changing the primary producer, applying industry technology within the product technology framework, making by-products, introducing new products, correcting errors in the supply and use table, and making manual corrections to symmetric input-output tables.

Merge industries

If two or more products are produced more or less simultaneously, it is often difficult to distinguish the production processes of those products. For example, two closely related industries are restaurants (NACE 55.3) and bars (NACE 55.4). Restaurants will have a lot of secondary output of beverage serving services (CPA 55.4, the main product of bars), while bars will have a lot of secondary output of food serving services (CPA 55.3, the main product of restaurants). It will be difficult to distinguish separate input structures for beverage serving services and food serving services, since both services are usually provided simultaneously. It is basically a form of joint production. Trying to distinguish separate input structures by applying the product technology may lead to negative elements.

It would be better to aggregate such industries and hence the products before applying the product technology. The assumption is then that both products are produced in the same production process. Merging the industries removes the secondary outputs and prevents negatives.

Merging industries can be a convenient solution to many cases. The apparent disadvantage of increasing the heterogeneity of the database is in fact not so important, since the input structures merged are similar anyway. If the compatibility with the supply and use tables at publication level is desired, the merger of industries can be applied to any industry below that level. In the above example, if e.g. the supply and use tables and symmetric input-output tables are published at the 2-digit NACE and CPA level, there is no problem in aggregating bars and restaurants.

Change primary producer

It was noted that it must be known which industry is the primary producer for each product if the product technology assumption is applied. In some cases it can occur that negatives are created because the initially chosen primary producer of a product is not the right one. In such a case, the input structure of another industry might be more appropriate to use as starting point.

It has to be remembered that in most cases there are many more products than industries, and hence there can be products for which it is not immediately obvious which the primary producer actually is, especially when they are rather heterogeneous products.

Apply industry technology within the product technology framework

In case that the product technology is not valid because there are in fact two ways of producing a product, one way of resolving this problem is to apply the industry technology assumption. This is done as described below, using the example from section 11.3 as illustration.

The industry technology assumption assumes that all products produced by agriculture are produced in the same production process. Thus, it does not matter whether they are called agricultural products or manufacturing products, they are all primary products. The secondary output could thus be added to the primary output. However, we should then do the same in the use table, that is, we should transfer the corresponding amounts (20) from the manufacturing products row to the agricultural products row. We have to decide which users buy these 20 units. It is easy to see that this is exactly the same problem as the one that has to be solved when compiling industry-by-industry tables.

We argued in section 11.3 that the assumption of fixed product sales structures is the more plausible of the two alternatives. This assumption could be complemented with actual data, if available. Using this assumption would lead to the resulting tables given in section 11.3. Since the 20 units of secondary output of agriculture is the only secondary output in the example, these are directly transferred to the symmetric input-output table.

The drawback of this solution is that it leads to a reclassification of products. The heading "agricultural products" in the symmetric input-output table does not contain the same products as the same heading in the supply and use tables. This could be a problem for users. In that case, this solution could still be applied in cases where the reclassification stays within the product groups distinguished in the most detailed published tables.

Make by-products

The product technology might be flawed because of the existence of by-products. For by-products, the Stone treatment could be an option. See section 11.5.

Introduce new products

Another possibility is to introduce a new product. It could well be that there exist two or more ways to produce a product. If there is sufficient information on the different production processes available, this could be added to increase the homogeneity of the symmetric input-output table. It goes too far for this manual to describe the mechanics of this procedure. It is fully elaborated in Konijn and Steenge (Konijn and Steenge 1995). The drawback of this method is the labour and data intensity.

Correct errors in supply and use tables

Wherever it can be established that negatives (or other implausible results) are caused by errors, it should of course be repaired by correcting the data.

The problem here is that symmetric input-output tables are usually compiled after the "closing" of the accounts, i.e. after the definitive supply and use tables are established, especially when symmetric input-output tables are only compiled once every five years. In such a case, when the compilation of the symmetric input-output tables revealed some problems in the supply and use tables these can often only be resolved at the next benchmark revision.

Make manual corrections to symmetric input-output tables

Finally, if (large) negatives remain that cannot be dealt with by any of the above solutions, for example because it would affect the compatibility with the original supply and use tables too much, they could be resolved by correcting the results of the product technology manually. The German statistical office has developed an approach with "special transformation matrices" that allows to incorporate manual corrections. The Austrian statistical office has identified ten problem areas for large negatives which are corrected during a manual correction.

11.5 Derivation of input-output tables in practice

In this paragraph it is discussed which practical problems may arise if product-by-product input-output tables are compiled with the product technology assumption.

11.5.1 Making supply and use tables square

In many countries, the supply and use tables are rectangular in the sense that there are many more products than industries distinguished. The CPA product classification is indeed much more detailed than the NACE industry classification. Thus, for example, the primary output of an industry at 3-digit NACE level can be broken down in various products at 4 or 5-digit CPA level. This is in particular the case for goods, much less for services.

Before applying the product technology, each product should be assigned to a primary producer. The existing link between CPA and NACE normally will provide an easy assignment of products to industries. Several products will have to be assigned to the same industry. That implies that in the product technology these products are assumed to share the same input structure. There may be cases, for example if products are distinguished at the working level that do not exactly correspond to a CPA number, where the assignment is not obvious and has to be made on the basis of assumed technology.

The assignment of products to industries can then be used to aggregate the supply table to obtain a "square" version. This is required to apply the product technology assumption. It is strictly speaking not required to aggregate the use table at this stage. However, to ultimately obtain a square symmetric input-output table, an aggregation of the use table will be necessary at some point. It may therefore also be done before the calculation of the symmetric input-output table.

11.5.2 The calculation of the symmetric input-output table

There are basically two ways of carrying out this important step: using the matrix multiplication or Almon's method.

Matrix multiplication

We saw above that in the product technology

*Use table = IO coefficient matrix * Supply table.*

Thus, the IO coefficient matrix can be calculated as

*IO coefficient matrix = Use table * inverse(Supply table)*

This formula shows clearly why the supply table has to be square. The symmetric input-output table (in values) itself is then obtained by multiplying the IO coefficients with the corresponding product output levels. See the next subchapter for more precise formulas.

The procedure will result in a matrix with a large number of very small elements, many of which are negative. Many elements are in fact not significantly different from zero. The causes of the larger negative elements have to be analysed in detail. The solutions of section 11.4.4 (Dealing with negatives) should be used to remove some of the causes of the negatives. This leads to changes in the product or industry classification, the assignment of products to primary industries, or corrections for errors.

When these adjustments have been made, the symmetric input-output models can be calculated again, resulting in less negative elements. This can be continued until the number and value of the negative elements becomes acceptable. This is the case when it can be considered that these negatives are the normal "noise" in the compilation process, due to unavoidable heterogeneity and statistical error within the normal confidence ranges. In terms of the formulae used here: the symmetric input-output table will be acceptable if the “difference matrix” is acceptable.

At that stage the remaining negatives can be eliminated. A rounding procedure on the values of the symmetric input-output table will already remove all insignificant elements (positive and negative). The final balancing can be done using a mathematical routine such as the RAS procedure. By setting all negatives to zero (and perhaps adjusting manually some clearly wrong positive elements) and then adjusting with RAS to match the totals, the necessary compensations will automatically be made. It must be realised that these adjustments are very minor to the total value contained in the symmetric input-output table and should fall within the normal statistical error. If that is not the case, more work has to be done on removing negatives.

A final check on the symmetric input-output table obtained in this way can be done by re-calculating the use table.

Almon’s method

Clopper Almon from the University of Maryland developed a method which is fully consistent with the product technology assumption and calculates a non-negative symmetric input-output table directly (Almon 2000). The method is not an alternative to product technology, only a special mathematical algorithmn to calculate the symmetric input-output table which is based on product technology assumption.

The method applies the product technology by calculating the SIOT row by row, and taking care of negatives as soon as they appear. What it does is to monitor the transformation process outlined in section 11.2 step-by-step for each row (i.e. product). The moment a negative threatens to appear, the amounts transferred are reduced. Box 11.4 demonstrates the Almon procedure by an empirical example. The method leaves the row totals unaffected, but there is no guarantee that the column totals are maintained. It is therefore necessary to perform a RAS procedure or the like to balance again row and column totals.

The fact that no negatives appear also means that the negatives cannot be used to analyse the quality and homogeneity of the supply and use tables. However, the results of Almon’s method can be checked by recalculating the use matrix (see next section). In a similar way as above, this check gives information on where to improve the supply and use tables or the product classifications.

Comparing both methods

Statistics Netherlands has compared both methods of calculating the symmetric input-output tables in terms of results and ease of use (Vollebregt and van Dalen 2002). It turned out that it is difficult to give a clear argument in favour of one or the other. In terms of computing time, both methods are equivalent. If well-programmed, both methods can be easy to use, although for both it remains necessary to address the largest negatives manually.

The Almon method had a slight advantage compared to the RAS procedure: the adjustments that need to be made by RAS are generally smaller than in the matrix multiplication method. Also, the distance between the recalculated “New Use” matrix and the original use matrix is smaller for Almon. The more negatives are taken care of manually, the more the two methods converge.

The results of the two methods may differ. It is, however, not easy to predict where differences will occur and how large they will be.

11.5.3 Recalculation of the use table

Independent of the choice between the two methods set out in the previous section, a symmetric input-output table will produce a result that will not be entirely consistent with the original supply and use tables. As described in section 11.3 due to remaining heterogeneity and errors, we obtain the following model:

*Use table = IO coefficient matrix * Supply table + Difference matrix* with a non-zero difference matrix. The difference matrix can be obtained by first calculating the "New Use" matrix, as elaborated in the previous section.

The differences between the original and the recalculated use tables can be interpreted as indicating the adjustments that would have to be made to the use table to make it consistent with the symmetric input-output table. The differences should therefore be within the normal statistical error in the elements of the use table. To evaluate whether this is the case, the differences should be reviewed by the compilers of the columns of the use table. If some of the differences are unacceptably large, further work on refining the ymmetric input-output table must be done.

11.6 Practical problems

11.6.1 Treatment of by-products

A traditionally difficult problem for input-output analysis has been by-products. With the introduction of supply and use tables, it is no longer difficult to *describe* by-products properly in the system, since they are simply one type of secondary production. However, they still create a problem for symmetric input-output tables. The problem with by-products is that they can disturb demand-supply relations in input-output analysis. If the 20 units of secondary production in the example of section 11.2 were by-products, and if there were additional demand for manufacturing products, it should induce additional production of the manufacturing industry rather than the agricultural industry. The issue has been debated a lot in literature, but a truly satisfactory solution has not yet been found.

Richard Stone devised a method for treating by-products which can be a solution in certain cases. According to Stone's method (Stone 1984), by-products are treated as negative inputs of the producing industry. To explain the method, we use the following example:

Box 11.4: Almon procedure

Clopper Almon developed a procedure which is able to compile symmetric product-by-product input-output tables from supply and use tables using the product-technology assumption with no negative flows.

In Scenario A the traditional transformation of the supply and use tables to symmetric input-output tables with the product technology assumption (Model A) does not result in negative flows. However, a marginal change of the use table in Scenario B does result in negative flows. In Scenario A, the Almon procedure generates the same result as the traditional transformation with Model A. However, in Scenario B it is demonstrated how negative transactions can be avoided by using the Almon procedure. The final result of the Almon procedure reflects the fact that rennet is only used in the cheese industry. In addition, the Almon procedure gives an indication in the sheet "New use table" how the use table can be revised to avoid negatives in the compiled product-by-product input-output table. In fact, in the example of Almon the new use table of Scenario B corresponds with the original use table of Scenario B.

SCENARIO A

Supply table

		Industries					q
		Cheese	Ice Cream	Choco-late	Rennet	Other	
Products	Cheese	70	30				100
	Ice Cream	20	180				200
	Chocolate			100			100
	Rennet				20		20
	Other					535	535
	g′	90	210	100	20	535	

Use table

		Industries					y	q
		Cheese	Ice Cream	Choco-late	Rennet	Other		
Products	Cheese						100	100
	Ice Cream						200	200
	Chocolate	4	36				60	100
	Rennet	14	6					20
	Other	28	72	30	5		400	535
	W	44	96	70	15	535		760
	g′	90	210	100	20	535	760	

Product technology assumption

Product-by-product input-output table

		Products					Y	q
		Cheese	Ice Cream	Choco-late	Rennet	Other		
Products	Cheese						100	100
	Ice Cream						200	200
	Chocolate		40				60	100
	Rennet	20						20
	Other	30	70	30	5		400	535
	W	50	90	70	15	535		760
	g′	100	200	100	20	535	760	

SCENARIO B

Supply table

		Industries					q
		Cheese	Ice Cream	Choco-late	Rennet	Other	
Products	Cheese	70	30				100
	Ice Cream	20	180				200
	Chocolate			100			100
	Rennet				20		20
	Other					535	535
	g′	90	210	100	20	535	

Use table

		Industries					y	q
		Cheese	Ice Cream	Choco-late	Rennet	Other		
Products	Cheese						100	100
	Ice Cream						200	200
	Chocolate	3	37				60	100
	Rennet	15	5					20
	Other	28	72	30	5		400	535
	W	44	96	70	15	535		760
	g′	90	210	100	20	535	760	

Product technology assumption

Product-by-product input-output table

		Products					Y	q
		Cheese	Ice Cream	Choco-late	Rennet	Other		
Products	Cheese						100	100
	Ice Cream						200	200
	Chocolate	-1.67	41.67				60	100
	Rennet	21.67	-1.67					20
	Other	30	70	30	5		400	535
	W	50	90	70	15	535		760
	g′	100	200	100	20	535	760	

Almon procedures

Product-by-product input-output table

		Products: Cheese	Ice Cream	Choco-late	Rennet	Other	Y	q
Products	Cheese						100	100
	Ice Cream						200	200
	Chocolate		40				60	100
	Rennet	20						20
	Other	30	70	30	5		400	535
	W	50	90	70	15	535		760
	g′	100	200	100	20	535	760	

New use table

		Industries: Cheese	Ice Cream	Choco-late	Rennet	Other	Y	q
Products	Cheese						100	100
	Ice Cream						200	200
	Chocolate	4	36				60	100
	Rennet	14	6					20
	Other	28	72	30	5		400	535
	W	44	96	70	15	535		760
	g′	90	210	100	20	535	760	

Almon procedures

Product-by-product input-output table

		Products: Cheese	Ice Cream	Choco-late	Rennet	Other	Y	q
Products	Cheese						100	100
	Ice Cream						200	200
	Chocolate		40				60	100
	Rennet	20						20
	Other	30	70	30	5		400	535
	W	50	90	70	15	535		760
	g′	100	200	100	20	535	760	

New use table

		Industries: Cheese	Ice Cream	Choco-late	Rennet	Other	Y	q
Products	Cheese						100	100
	Ice Cream						200	200
	Chocolate	4	36				60	100
	Rennet	14	6					20
	Other	28	72	30	5		400	535
	W	44	96	70	15	535		760
	g′	90	210	100	20	535	760	

Formulas for Almon Procedure in Box 11.7

Box 11.5: Product technology assumption versus Almon transformation

The supply and use tables of Hungary 2000 were used to compare the results of the product technology assumption (Model A) with the corresponding results of the Almon procedure (Model F). Both models were used to transform supply and use tables at basic prices to product-by-product input-output tables.

The disadvantage of the product technology assumption is that the model is often generating a large number of negative entries. Several hundred small negative entries were observed in the larger product-by-product input-output table of Hungary with 60 sectors (P60).

The main advantage of the Almon procedure is that the transformation is not generating negative flows although basically the product technology assumption is applied. Its disadvantage is that sometimes transactions are disappearing where inputs are expected. The remaining negative flow in the Almon table has to do with a negative entry in the supply table related to the import of natural gas and the associated significant negative trade margin on the product side.

The Almon procedure is a valid choice to eliminate small negative flows. Large negative flows should be removed in a manual balancing procedure.

Intermediate consumption of domestic products based on product technology assumption Millions of HUF

No	PRODUCTS \ HOMOGENEOUS BRANCHES	Products of agriculture, hunting and forestry	Fish	Products from mining and quarrying	Manufactured goods	Electrical energy, gas, steam and hot water	Construction work	Wholesale and retail trade services, repair services	Hotels and restaurant services	Transport, storage and communication services	Financial intermediation services	Real estate, renting and business services	Public administration and defense services	Education services	Health and social services	Other community, social and personal services	Total
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Products of agriculture, hunting and forestry	223297	973	52	551438	276	631	15669	10756	2375	17	1325	9426	235	5113	3376	824959
2	Fish	-12	264	0	87	0	-2	-10	662	-2	0	-2	-1	-2	0	-3	979
3	Products from mining and quarrying	598	29	7449	38054	47918	13102	-232	131	1323	0	-868	421	504	524	799	109752
4	Manufactured goods	285108	614	28483	1544516	72277	312180	158588	100833	174236	29242	183340	62953	28991	76114	60506	3117981
5	Electrical energy, gas, steam and hot water	23288	318	5983	238099	82077	9788	35262	14723	30333	6430	26843	32103	17926	14516	24718	562407
6	Construction work	7086	29	127	33183	11518	23204	24719	7208	39904	3959	58734	10451	11108	6379	12054	249663
7	Wholesale and retail trade services, repair services of motor vehicles, motorcycles and personal and household goods	108914	-119	7216	368035	-94634	161612	105258	20863	72934	9308	89136	20454	9671	24142	28415	931205
8	Hotels and restaurant services	852	12	1283	21153	734	5848	12551	21782	10325	191	11758	5644	1163	11265	7089	111650
9	Transport, storage and communication services	23875	196	11203	249061	32791	54362	204182	13233	92580	31977	78096	33461	11010	10029	68169	914225
10	Financial intermediation services	7780	56	1164	62209	9043	11204	51226	6364	21373	108627	42514	7930	3074	3688	8422	344674
11	Real estate, renting and business services	10136	11	8487	280980	45999	23990	414933	33515	137528	106237	342654	46656	36503	20688	118014	1626331
12	Public administration and defense services; compulsory social security services	4601	19	276	27913	2589	4558	11121	4604	14705	5393	7449	5461	5518	1370	14525	110102
13	Education services	819	11	191	14504	1312	1952	8773	374	4616	4389	9726	3053	11411	2439	4372	67942
14	Health and social services	7111	44	104	10138	554	2291	10068	898	4043	840	2892	1942	1127	37605	2103	81760
15	Other community, social and personal services	3371	16	962	51240	4534	2718	37959	5839	16327	21092	41128	6019	6259	6551	53683	257698
16	Total	706824	2473	72980	3490610	216988	627438	1090067	241785	622600	327702	894725	245973	144498	220423	406242	9311328

Intermediate consumption of domestic products based on Almon transformation Millions of HUF

No	PRODUCTS \ HOMOGENEOUS BRANCHES	Products of agriculture, hunting and forestry	Fish	Products from mining and quarrying	Manufactured goods	Electrical energy, gas, steam and hot water	Construction work	Wholesale and retail trade services, repair services	Hotels and restaurant services	Transport, storage and communication services	Financial intermediation services	Real estate, renting and business services	Public administration and defense services	Education services	Health and social services	Other community, social and personal services	Total
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Products of agriculture, hunting and forestry	221368	1208	98	540275	347	936	26205	10446	2591	15	3015	9459	400	5111	3485	824959
2	Fish	9	248	0	81	0	0	0	631	0	0	7	0	0	3	0	979
3	Products from mining and quarrying	789	34	6425	38780	47714	11431	147	142	1565	0	393	469	512	525	826	109752
4	Manufactured goods	288305	994	15332	1547972	84575	281454	179279	97989	179510	26983	188551	64526	29723	75531	57257	3117981
5	Electrical energy, gas, steam and hot water	24435	337	4759	237945	81290	10130	38198	14367	30622	5822	27393	32159	17826	14456	22668	562407
6	Construction work	7656	52	263	36097	12031	21168	25634	7191	39183	3788	57044	10546	11038	6382	11590	249663
7	Wholesale and retail trade services, repair services of motor vehicles, motorcycles and personal and household goods	109349	53	3628	374895	-88617	146033	111056	20617	74879	8422	88548	21072	9927	24006	27337	931205
8	Hotels and restaurant services	1236	19	345	22477	1098	5311	12823	20973	10590	173	11531	5693	1264	11151	6966	111650
9	Transport, storage and communication services	27959	262	7928	256257	35026	49891	200260	13246	93806	30485	78501	33647	11130	10053	65774	914225
10	Financial intermediation services	8636	70	686	65153	9566	10669	50755	6302	26017	102847	40523	7995	3126	3690	8639	344674
11	Real estate, renting and business services	17572	88	5375	302672	48817	25499	402582	33470	144547	99997	321994	46841	36737	20790	119350	1626331
12	Public administration and defense services; compulsory social security services	4863	30	214	28355	3121	4254	11433	4498	14443	5322	7454	5476	5489	1386	13764	110102
13	Education services	1033	13	101	15094	1421	1857	8803	406	4816	4206	9048	3067	11340	2438	4299	67942
14	Health and social services	6965	49	83	10842	665	2117	9736	978	4088	780	2897	2046	1271	37163	2080	81760
15	Other community, social and personal services	4643	49	654	52462	4809	2940	38141	5819	18233	19084	39410	6042	6272	6541	52599	257698
16	Total	724818	3506	45891	3529357	241863	573690	1115052	237075	644890	307924	876309	249038	146055	219226	396634	9311328

Hungary 2000

Table 11.19: Supply and use tables and by-products

	USE TABLE					SUPPLY TABLE			
	Blast furnace	Power plant	Gas distribution	Final demand	Total	Blast furnace	Power plant	Gas distribution	Total
Steel	0	0	30	70	100	100	0	0	100
Electricity	40	20	20	60	140	0	140	0	140
Gas	0	20	0	60	80	20	0	60	80
Value added	80	100	10		190				
Total	120	140	60	190		120	140	60	

A blast furnace produces an amount of gas as by-product in the production process of steel. The gas is delivered to a power plant to produce electricity. The gas delivered by the gas distribution industry is all consumed by final users. Applying the product technology to this by-product is clearly wrong, since the input structure of the gas distribution industry will not be valid for the blast furnace gas. Applying the industry technology would also be wrong, since that would lead to increases in the production of steel when the demand for electricity grows.

Stone therefore proposed to treat the by-product as a negative input, resulting in:

Table 11.20: Stone proposal

	USE TABLE					SUPPLY TABLE			
	Blast furnace	Power plant	Gas distribution	Final demand	Total	Blast furnace	Power plant	Gas distribution	Total
Steel	0	0	30	70	100	100	0	0	100
Electricity	40	20	20	60	140	0	140	0	140
Gas	- 20	20	0	60	60	0	0	60	60
Value added	80	100	10		190				
Total	100	140	60	190		100	140	60	

If there is extra demand for steel, due to fixed input-output coefficients, the negative input, i.e. output, of gas increases too. If there is extra demand for electricity, this will boost demand for gas, but this will be produced with the “proper” input structure of the gas distribution industry.

The total production of the economy is reduced by 20 (but not value added). This could be a disadvantage if full compatibility with the original SUT is required.

The method recommended by the previous version of the ESA, ESA 79, involved the introduction of a special row in the use table for transfers of secondary products. In the example, the transfer row would include -20 in the column for blast furnace and +20 in the column for gas. All other values in the use table are unaffected. The supply table is rendered diagonal by putting the total production of products on the diagonal.

Table 11.21: Transfers in supply and use tables

	USE TABLE					SUPPLY TABLE			
	Blast furnace	Power plant	Gas distribution	Final demand	Total	Blast furnace	Power plant	Gas distribution	Total
Steel	0	0	30	70	100	100	0	0	100
Electricity	40	20	20	60	140	0	140	0	140
Gas	0	20	0	60	80	0	0	80	80
Value added	80	100	10		190				
Transfers	- 20	0	20						
Total	100	140	80	190		100	140	80	

In effect, the input structure of gas is the same as in the product technology model, except that the coefficients would not add up to one, due to the transfer row (the +20 on the transfer row in the column for gas is not an input into producing gas). The use matrix becomes the symmetric input-output table without change. The method does maintain the total production values, but does not seem to yield a meaningful input-output table for analysis.

11.6.2 Symmetric input-output tables for domestic production and imports

The symmetric input-output table discussed so far does not differentiate between the use of domestically produced products and imported products. If such a table were to be used in input-output analysis, the implicit assumption would be made that imported products were produced in the same way as they are produced domestically or that they were a full substitute to domestic output. This is often a highly unrealistic assumption, since foreign production processes may differ considerably from the domestic processes. Furthermore, there are likely to be several products that are not or cannot be produced domestically.

For this reason, ESA 1995 requires an additional split of the symmetric input-output table in two tables: one containing only the use of domestically produced products (table 9.13 of ESA 1995), and one containing the use of imported products. Using the first mentioned table in input-output analysis avoids the use of the unrealistic hypothesis mentioned above, but has the disadvantage that the inputs used in producing the imported products are not counted. For example, if the aim of the analysis is to calculate the total energy used to produce one unit of a particular product, then the energy used to produce imported inputs should also be included. The choice between the two types of tables for input-output analysis depends therefore to a large extent on the aim of the analysis.

The compromise solution would be to try to make a distinction between those imports that are produced in similar production processes as domestically used, and those imports of which the production processes are very different (not necessarily the same as complementary imports). For the latter, one may then - if desired for the analysis - try to add information on their input structures.

To be able to make the split between domestically produced outputs and imports, the use table should be subdivided similarly (see chapter 7 of this manual). If that is available, then there are two ways in which the split of the symmetric input-output table can be achieved.

The first method is to apply the same transformation procedure as carried out for the total symmetric input-output table to the table for domestic output (the table for imports follows as the difference between the total use and use of domestic products). The implicit assumption is then that the product technology assumption extends to the domestic product/import divide, which is a very strong assumption. Furthermore, when applying the product technology model to the table with domestic output, negatives may appear in different places than were found for the total table. It will be quite difficult to ensure consistency between the total symmetric input-output table and the symmetric input-output table with domestic output.

Another approach is to take the ratio of domestic output and import for an element of the use table as starting point, and to assume that this ratio applies to all products produced by the respective industry. In other words: the domestic output and import ratio of a particular input of an industry is applied to all products for which this input is used by that industry. The total of imported products (or domestically produced products) used to produce a product is then calculated by aggregating the industries producing that product. This assumption seems less strong than the one described in the previous paragraph, because it assumes that an industry does not differentiate between the inputs it bought on the domestic market and on the international market.

Table 11.22: Domestic output and imports – an example

	Product 1	Product 2	Total
Intermediates	80	120	200
Value added	20	180	200
Total	100	300	400

	Product 1	Product 2	Total
Domestic intermediates	60	90	150
Imported intermediates	20	30	50
Value added	20	180	200
Total	100	300	400

An example might illustrate this. Suppose an industry produces 100 units of product 1 and 300 units of product 2. The symmetric input-output table informs us that for producing 1 unit of product 1 0.8 units of a certain input are required while for producing 1 unit of product 2 0.4 units of that input are needed. The industry therefore uses in total 100*0.8+300*0.4 = 80 + 120 = 200 of this input. The domestic product/import split of the use table shows that of those 200, 150 were purchased from domestic producers and 50 were imported. This ratio 150/50 is then applied to the use of this input for both products. So, of the 80 units used for product 1, 60 are assumed to be domestically produced and 20 imported. Similarly, of the 120 units used for product 2, 90 are assumed to be domestically produced and 30 imported. The method is elaborated mathematically in Box 11.6.

The method avoids the risk of getting negatives in the symmetric input-output table for domestic output or the symmetric input-output table for imports. However, some risks of inconsistency can arise, due to the fact that the "difference matrix" is not zero, i.e. we do not have exactly

*Use table = IO coefficient matrix * Supply table.*

This might mean that the sum of imports by product will not add up exactly to the total as given by the use table. This is further discussed Box 11.6 where a solution is given.

11.6.3 Symmetric input-output tables at constant prices

ESA 1995 also requires Member States of the European Union to submit symmetric input-output tables at constant prices. However, it is not specified which reference year should be used for those tables. This is in particular a problem for symmetric input-output tables because they are only required once every five years.

In the meantime Member States are required to use the previous year as base year in their constant price calculations. For a number of countries that currently use a fixed base year, transitional periods were agreed to enable them to make the change to the new system. For the submission of constant price data to Eurostat, countries that use the previous year as base year are requested to send data both at prices of the previous year *and* "chained" data at prices of a fixed reference year.

The supply and use tables at constant prices (see chapter 8) will therefore generally be compiled at prices of the previous year. This enables the calculation of growth rates by comparing the constant price values with the current price values of the previous year. Results of "chaining" complete supply or use tables will not be additive, i.e. supply and use tables will result in which the elements of a row will not add up to the row total (similarly for the columns). The resulting tables can only be used to analyse the time path of one particular element at the time. They cannot be used very well for e.g. the analysis of the time path of the total input structure of an industry or the market shares for a product.

For symmetric input-output tables, if they are only compiled once every five years, it is of course possible to use the previous year's prices as well, but the results cannot be used to calculate growth rates, which would clearly reduce the usefulness of such tables.

The alternative would be to compile a symmetric input-output table in prices of the year five years prior to the current year (e.g. 2005 in prices of 2000). This could be done by performing the same transformation process as for the current price symmetric input-output tables, but this would require the availability of coherent supply and use tables in the same valuation, which is a problem when "chaining" is used, as mentioned above.

Another possibility of deriving such a symmetric input-output table is to deflate directly the symmetric input-output table at current prices, by finding appropriate price or volume indices for the products. These should be indices of the price or volume change in the five years between the base year and the current year. This procedure implies the use of a different base year than for the supply and the tables at constant prices, introducing the risk of inconsistencies. The best approach of course would be to compile symmetric input-output tables annually, and applying the same price and volume methodology as used for the supply and use tables.

11.7 Compilation issues

The following discussion of compilation of input-output tables in practice including the illustrative numerical examples on rectangular supply and use tables and evaluation of input-output and quality in official statistics were derived from Thage (2000a) and Thage (2005).

11.7.1 Rectangular supply and use tables

An important advantage of the market share method of Model D is that the symmetric input-output tables can directly be derived from the rectangular supply and use tables, without any intermediate aggregation to square supply and use tables. Consequently, the question of defining characteristic products and making a formal distinction between primary and secondary production does not arise, and as illustrated both in the numerical and empirical examples in this chapter this method reduces the aggregation loss of information. This does not exclude the introduction of special knowledge that modifies this assumption, but this must happen already in the supply and use system, and thus also in the basic framework of the national accounts. The aggregation loss of information when rectangular supply and use tables are aggregated to a square format prior to the compilation of the symmetric input-output tables will happen no matter which kind of symmetric input-output table is constructed from these square tables.

Table 11.23: Rectangular supply and use system

Square supply and use system

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	0	80	50	130	130	0	130
Manufactured products	60	30	130	220	20	200	220
Wages and salaries	60	20	0	80	0	0	0
Operating surplus	30	70	0	100	0	0	0
Total	150	200	180		150	200	350

Rectangular supply and use system

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	0	80	50	130	130	0	130
Manufactured product 1	30	30	20	80	20	60	80
Manufactured product 2	30	0	110	140	0	140	140
Wages and salaries	60	20	0	80	0	0	0
Operating surplus	30	70	0	100	0	0	0
Total	150	200	180		150	200	350

The next numerical examples are used to illustrate the fundamental differences between the following two approaches:

- A product-by-product table based on the assumption of a product technology (Model A)
- An industry-by-industry table based on the assumption of fixed product sales structures (Model D)

The other two types of standard tables (Model B and Model C) are considered less relevant.

The numerical example is the same as the one used in this chapter except that the number of manufacturing products has been expanded to two products (product 1 and product 2) instead of one, but the totals for manufacturing remain unchanged. This makes both the supply and the use table rectangular. The data in Table 11.23 is the basis for the following analysis. Manufactured product 1 is produced both in agriculture (20) and in manufacturing (80), and the two products have different row distributions in the use matrix.

Product-by-product table based on the product technology assumption (Model A)

The product-by-product table based on the product technology assumption (Model A) is constructed in the same way as shown in the previous part of this chapter. This implies that the 20 units of manufactured product 1 are assumed to be produced with the average input structure of manufacturing. In the transformation table below this leads to the transfer of 10 per cent of the values towards the column for manufacturing; these values are deducted from the column for agriculture.

Table 11.24: Rectangular supply and use tables based on product technology assumption

Enlarged square supply and use system

	USE TABLE					SUPPLY TABLE			
	Agriculture	Manuf. Prod. 1	Manuf. Prod. 2	Final demand	Total	Agriculture	Manuf. Prod. 1	Manuf. Prod. 2	Total
Agricultural products	- 8	8	80	50	130	130	0	0	130
Manufactured product 1	27	3	30	20	80	0	20	60	80
Manufactured product 2	30	0	0	110	140	0	0	140	140
Wages and salaries	58	2	20	0	80	0	0	0	0
Operating surplus	23	7	70	0	100	0	0	0	0
Total	130	20	200	180		130	20	200	350

Aggregation to rectangular supply and use tables based on product technology assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	- 8	88	50	130	130	0	130
Manufactured product 1	27	33	20	80	0	80	80
Manufactured product 2	30	0	110	140	0	140	140
Wages and salaries	58	22	0	80	0	0	0
Operating surplus	23	77	0	100	0	0	0
Total	130	220	180		130	220	350

Derived square supply and use tables based on product technology assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	- 8	88	50	130	130	0	130
Manufactured products	57	33	130	220	0	220	220
Wages and salaries	58	22	0	80	0	0	0
Operating surplus	23	77	0	100	0	0	0
Total	130	220	180		130	220	350

There has been a discussion that all information about the transformation of the individual manufactured products is lost in this process. However, if you assume that the manufactured product 1 and the manufactured product 2 are produced with the input structure of the manufacturing industry, the rectangular supply and use system can be transformed to a larger symmetric system. This is actually demonstrated in Table 11.24. An alternative would be to employ linear programming techniques which can handle rectangular systems. It should be remembered that also in Model D (Fixed product sales structure) it is implicitly assumed that the various products are produced by the technology of the corresponding industries.

It is also seen that even though manufacturing produces two different products with different use structures we have to assume that they are produced with identical input structures to obtain the square product-by-product table. The characteristics that are traditionally associated with the industry technology, namely that different products are produced with the same "technology" are therefore also present below the surface when the product technology assumption is used, and may influence the result to a considerable extent compared to a situation where input structures of the individual products (at the rectangular supply table level) were known.

The resulting table has, except for the highly aggregated product groups in the square supply and use tables lost some comparability to other types of data set in national accounts and basic statistics. After all the transformation with the product technology assumption is an analytical step. Furthermore it contains a negative element that is obviously unrealistic, and requires further adjustments. The best way is to go back to the supply and use system and explore the reasons for large negatives.

Industry-by-industry table based on the fixed product sales structure assumption (Model D)

When the assumption of a fixed product sales structure is used the first step is to subdivide all elements of the row for manufacturing product 1 in the use table in the proportion 20:60 which signifies the overall market shares for agriculture and manufacturing for this product as it can be seen in the supply table. The assumption is thus that for all users of this product the two producing industries have the same market shares as they have for the total market. Here it is important to notice that the overall market share is observed, so that the assumption only relates to the individual elements in the row under this constraint.

The two sub rows for manufacturing product 1 obtained by this procedure are shown in Table 11.25. The two rows relate to agriculture and manufacturing as supplying industries. The assumption of fixed market shares is identical to an assumption about identical horizontal distributions for each individual product independently of which industry is the producer. Considering that the overall market share of the product for each industry is known, this is obviously a rather weak assumption. No matter how many products or industries the rectangular supply and use tables contain, the procedure is the same. When all products that are supplied from more than one industry have been subdivided in this way, the transformation table is still rectangular, the number of rows being equal to the number of elements in the supply matrix (in this example 4). Each row in this expanded matrix has a product as well as an industry code. In the next step the rows of the expanded matrix are added over the industries to obtain the industry-by-industry table. This transformation does not imply any deductions and subsequent transfers, but only subdivisions and subsequent additions of rows, as illustrated in Table 11.25.

It should be noted that all the details of the use table are carried through all the way to the resulting industry-by-industry table. When needed for analytical purposes it is possible to specify at the supply and use level of detail the products that are being used by the individual industries and categories of final uses. For analytical uses relating to energy, environment, imports, ICT and productivity etc. it is often useful to apply some of these product details along with the square industry-by-industry table. Furthermore this type of table can be directly linked with other production related data sets from national accounts and primary statistics such as labour, fixed capital formation and capital stock by industry.

It should be noted that the derivation of the symmetric input-output tables from the supply and use tables in this case does not require that the rectangular supply and use tables are first aggregated by products to become square. Neither (and for this very reason) does the derivation of the industry-by-industry table outlined above require any formal distinction between primary and secondary production. As the numerical example shows, detailed product information that would have disappeared if the rectangular supply and use tables had from the outset been aggregated to a square format play an important role in the way the symmetric input-output table is derived. This is also the reason why the internal part of the resulting table differs from the result obtained in the earlier example in Table 11.18, even though the (square) supply and use tables and the methods are identical. The differences illustrate the information loss suffered by not using all the detailed data available in the compilation process.

It should be underlined that the use of the two industries agriculture and manufacturing in this numerical example is just for illustrative purposes. In practice there will already at the supply and use level hardly be any secondary production that crosses the borderlines between broad industry groups such as agriculture, mining, manufacturing etc. (see the tabulation categories of the ISIC/NACE). Most secondary production belongs within the same broad industry group, in particular manufacturing industries, and is furthermore often produced in the neighbouring classes, so that the differences between primary and secondary production tends to be a minor problem compared to the variation in the product mix within industries at the supply and use level.

Sometimes it is argued that the assumptions underlying the industry-by-industry table are inconsistent with its use for input-output analysis. As pointed out earlier, any type of input-output analysis must necessarily assume an industry technology, as widely different baskets of products are assumed to be produced with identical input structures. It was furthermore pointed out above that a product-by-product table based on the assumption of a product technology approach already in the process of its construction implicitly relies on the assumption of an industry technology as soon as it is realised that the number of products exceed the number of industries.

Box 11.6: Square and rectangular supply and use systems

With the following examples it demonstrated for Model D (Fixed product sales structure assumption) that it is preferable to transform the supply and use tables at the most disaggregate level. The transformation of the rectangular supply and use system generates different results than the transformation of the symmetric supply and use system.

Square supply and use system

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	0	80	50	130	130	0	130
Manufacturing products	60	30	130	220	20	200	220
Wages and salaries	60	20	0	80	0	0	0
Operating surplus	30	70	0	100	0	0	0
Total	150	200	180		150	200	350

V	130	20		diag (q)	130	0	
	0	200			0	220	
inv(q)	0.0077	0.0000		T=V*inv(q)	1.0000	0.0909	
	0.0000	0.0045			0.0000	0.9091	
U	0.00	80.00		B = T * U	5.45	82.73	
	60.00	30.00			54.55	27.27	

Symmetric supply and use tables

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	5.45	82.73	61.82	150.00	150.00	0.00	150.00
Manufactured products	54.55	27.27	118.18	200.00	0.00	200.00	200.00
Wages and salaries	60.00	20.00	0.00	80.00	0.00	0.00	0.00
Operating surplus	30.00	70.00	0.00	100.00	0.00	0.00	0.00
Total	150.00	200.00	180.00		150.00	200.00	350.00

Rectangular supply and use tables

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	0	80	50	130	130	0	130
Manuf. Prod. 1	30	30	20	80	20	60	80
Manuf. Prod. 2	30	0	110	140	0	140	140
Wages and salaries	60	20	0	80	0	0	0
Operating surplus	30	70	0	100	0	0	0
Total	150	200	180		150	200	350

V	130	20	0	diag (q)	130	0	0
	0	60	140		0	80	0
					0	0	140
inv(q)	0.0077	0.0000	0.0000	T=V*inv(q)	1.0000	0.2500	0.0000
	0.0000	0.0125	0.0000		0.0000	0.7500	1.0000
	0.0000	0.0000	0.0071				
U	0.00	80.00		B = T * U	7.50	87.50	
	30.00	30.00			52.50	22.50	
	30.00	0.00					

Symmetric supply and use tables

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	7.50	87.50	55.00	150.00	150.00	0.00	150.00
Manufactured products	52.50	22.50	125.00	200.00	0.00	200.00	200.00
Wages and salaries	60.00	20.00	0.00	80.00	0.00	0.00	0.00
Operating surplus	30.00	70.00	0.00	100.00	0.00	0.00	0.00
Total	150.00	200.00	180.00		150.00	200.00	350.00

Formulas for transformation model in Table 11.27

Table 11.25: Rectangular supply and use tables based on the fixed product sales structure assumption

Rectangular supply and use system based on fixed product sales structure assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agricultural products	0.0	80.0	50.0	130.0	130.0	0.0	130.0
Manuf. Prod. 1 in Agr.	7.5	7.5	5.0	20.0	20.0	0.0	20.0
Manuf. Prod. 1 in Man.	22.5	22.5	15.0	60.0	0.0	60.0	60.0
Manuf. Prod. 2	30.0	0.0	110.0	140.0	0.0	140.0	140.0
Wages and salaries	60.0	20.0	0.0	80.0	0.0	0.0	0.0
Operating surplus	30.0	70.0	0.0	100.0	0.0	0.0	0.0
Total	150.0	200.0	180.0		150.0	200.0	350.0

Square supply and use system based on fixed product sales structure assumption

	USE TABLE				SUPPLY TABLE		
	Agriculture	Manufacturing	Final demand	Total	Agriculture	Manufacturing	Total
Agriculture	7.5	87.5	55.0	150.0	150.0	0.0	150.0
Manufacturing	52.5	22.5	125.0	200.0	0.0	200.0	200.0
Wages and salaries	60.0	20.0	0.0	80.0	0.0	0.0	0.0
Operating surplus	30.0	70.0	0.0	100.0	0.0	0.0	0.0
Total	150.0	200.0	180.0		150.0	200.0	350.0

11.7.2 Input-output and quality in official statistics

Many countries have for a considerable span of years compiled SIOTs either with five-yearly or irregular intervals, and some countries compile annual SUT and SIOT as an integrated part of their national accounts. From the experience obtained by these countries it is possible to identify procedures that can underpin recommendation on "best practices"– an approach which is in agreement with the process-oriented part of the quality frameworks.

In this chapter it is argued that the type of tables that best fulfils the standard quality criteria is the industry-by industry table based on the assumption of fixed product sales structures and the product-by-product input-output table based on the product technology assumption. These types of tables reflect the accumulated experience and current practice of those countries most permanently involved in the compilation of symmetric input-output tables.

Concerning the analytical properties of a symmetric input-output table, it is important to notice that in practice all analytical uses of input-output tables must implicitly assume an industry technology, no matter how the tables have originally been compiled. In view of the limited amount of secondary activities and from an analytical point of view the distinction between a product and an industry technology is thus of limited relevance. Furthermore any product-by-product table is in practice a manipulated industry-by-industry table, as it still contains all the institutional establishment (or even enterprise) characteristics of the supply and use tables.

The industry-by-industry table is not an approximation to a more "ideal" type of table. It exists in its own right as a relevant part of official statistics that fulfils central quality criteria, including user needs. But there is no ideal target type of table against which to measure the quality of the outcome.

The main quality characteristics of industry-by-industry input-output tables and product-by-product input-output tables are:

Transparency

- Industry-by-industry tables based on the fixed product sales assumption can be derived from the supply and use tables without much further effort and in such a way that negative elements do not appear. They provide more transparency on the compilation procedure.
- Product-by-product tables based on the product technology assumption are derived from the supply and use tables in a complex procedure. If negative elements appear a new balancing procedure is required. Manual balancing causes less transparency.

Comparability

- Industry-by-industry tables are closer to statistical sources, survey results and actual observations. More direct comparability is guaranteed with national accounts data.
- Product-by-product tables are further away from statistical sources and survey results. The results have been compiled in an analytical step which creates less comparability with the sources but guarantees more comparability across nations.

Inputs

- Symmetric industry-by-industry tables identify for each industry the input requirements from other industries. The same is true for the categories of final demand. Mixed bundles of goods and services rather than homogenous products are reported for intermediate and final uses.
- Symmetric product-by-product tables have a clear input structure in terms of products for intermediate use and value added for the compensation of labour and capital for homogenous branches.

Resources and timeliness

- Industry-by-industry tables are less resource intensive to produce. They can be directly derived from supply and use tables at basic prices. This requires fewer resources and guarantees a better timeliness.

- The compilation of product-by-product tables based on the product technology is more demanding as negatives may appear. The tables require more resources and balancing efforts. The publication of results is delayed.

Analytical potential

- Industry-by-industry tables are well suited for specific analytical purposes which are related to industries (tax reform, impact analysis, fiscal policy, monetary policy, etc.)
- Product-by-product tables are well suited for many other specific analytical purposes which are related to homogeneous production units (productivity, comparison of cost structures, employment effects, energy policy, environmental policy, etc.).

User friendliness

- Statistical offices should compile symmetric input-output tables in spite of the practical problems associated with them. Making available only supply and use tables would discourage many potential users.

The differences between product-by-product and industry-by-industry tables are caused by the existence of secondary production. The supply table shows the extent of secondary production as off-diagonal elements (when it is aggregated to a square matrix). The observed extent of secondary production depends on the level of aggregation of both products and industries and secondary production does therefore not possess any observable characteristics of its own. The relative character of the secondary production concept also indicates that it is difficult to justify that the input structure of a particular product (say product no 201 at a certain level of aggregation) should be of more interest than the input structure of the other 200 products produced by that industry, just because it is also produced as secondary production in another industry.

For most countries the supply matrix is characterised by having only secondary production for manufacturing industries or manufacturing products. For other industries only diagonal elements exist. There are two reasons for this. Firstly, for service industries the diagonal structure is usually simply due to the fact that no product specifications exist, so that total output from KAUs (or even legal or institutional units) must be assumed to be characteristic output of the industries in which the units are classified in the business register. Secondly KAUs for industries such as agriculture, construction and trade are often defined in a more product-oriented form in the national accounts than in the business register so that all secondary activities in these industries have already been transferred to the primary industry before the data are entered in the supply and use table (as also recommended in the two-step process outlined below) or the data are alternatively constructed in such a way that from the outset no secondary production exists – agricultural output as the sum of agricultural products, construction as the sum of the value of new construction and repairs etc.).

In practice as much as 70 percent (depending on the type of economic units applied) of all economic activity may be completely unaffected by whatever transformation procedure is used to construct symmetric input-output tables. The technology or transformation problem is thus, in practice, largely limited to the manufacturing industries and their output of industrial products. Considering the simplified way the rest of the economy is dealt with (primarily due to lack of relevant data sources), the efforts and theoretical refinements attached to the transformation procedures for manufacturing industries should be proportionate.

The size of sampling and non-sampling errors associated with the primary data on which the SUT is based, and the fact that a considerable part of the data contents of the SUT is usually obtained by grossing-up methods, extrapolations, estimates of a more or less subjective nature and even model calculations should be kept in mind when choosing the method for constructing the SIOT. Furthermore purchases for intermediate consumption by products are at best collected for kind of activity units (KAU), and in most cases the statistical coverage of purchases is irregular and and/or highly aggregated. Another important source of error in the detailed output and input data is connected with the transformation from observed data on sales and purchases to the national accounts concepts of production and intermediate consumption, and the fact that sales and purchases are not evenly distributed over the year (the changes in inventories problem).

Thus the effects of non-sampling errors such as misclassifications and biases in grossing-up methods may alone represent a magnitude more important than the total secondary production (at a particular level of aggregation). There are no ex post methods by which such errors can be identified and corrected when they have already passed the test of a balanced supply and use system. Compilation methods for the symmetric input-output tables should therefore not assume an accuracy of the data that is not commensurate with the actual knowledge about data quality.

The completion of the balanced supply and use tables should also represent the completion of the data related work. If collection of additional basic statistics continues at this late stage of the compilation process, it would be necessary to turn the work sequence upside down. As the supply and use tables are compiled annually the methods used should be "self-contained" and not depend on the subsequent compilation of symmetric input-output tables. Thus the data contents of the supply and use tables are much closer related to the compilation of the (final) annual national accounts than to the symmetric input-output table. Only in this way is it possible to obtain a proper time series of supply and use tables that can be integrated with the national accounts, and used for consistent constant price calculations etc.

The problem of the negative elements that usually results when product-by-product tables are constructed on the assumption of a product technology should also be considered on the background of the accuracy of the source data. There are many possible reasons for the negatives. The most important one is no doubt that the assumption of a product technology does not reflect any economic or statistical realities at this level of aggregation. However, even if the assumption of a product technology were correct, the method would require that the data in the supply and use tables were absolutely accurate.

In practice it is not possible to decide to which extent negatives are caused by the technology assumption or errors in data. This occurs basically because the target variables can not be observed statistically. An attempt to do so would be very time-consuming, and would imply the collection of additional basic statistics at this late stage of the compilation process, which would necessitate turning the work sequence upside down. The efforts spent on the elimination of the negatives may be misdirected, as even more important problems can be hidden in the positive elements, and the procedures applied to eliminate the negatives may adversely affect basically sound data.

11.7.3 Products, units and technology

The product-by-product table is the preferred type of symmetric input-output tables according to ESA 1995. It is closely related to a particular understanding of the concept of a "product". In economic theory products are – in a very general sense – produced by means of products, labour and capital. Each product is characterised by a separate production function which describes a specific technology, i.e. a technology is fully described in terms of a set of products. However, an analogy between this theoretical conception and the properties of the statistical input-output tables is difficult to establish, as they represent two different levels of abstraction.

At the input-output level of aggregation there are no "homogeneous" products or production processes of the individual type. The economy consists of hundreds of thousands or even millions of producing units, of which hardly even two are completely identical, and there are millions of different products and even more production processes. The recommendations on how to construct symmetric input-output tables are often based on numerical or mathematical examples that assume that at a high level of aggregation economy can be represented by a set of homogeneous products and production functions. These models may not always convey useful advice on how to solve the practical problems faced by the compiler of a symmetric input-output table.

When compared to the real world, magnitude of products and production processes, even detailed basic statistics already represent a major aggregation. Statistics on products are collected at a maximum detail of say 10 000 products, and that only in selected areas such as foreign trade statistics and perhaps output from manufacturing industries. Furthermore products that are identical in a physical sense are different in an economic sense when they are sold at different prices to different purchasers. The concept of basic prices is defined to specifically include this possibility. Purchases for intermediate consumption by products are at the best collected for kind of activity units (KAU), and in most cases the statistical coverage of purchases is irregular and and/or highly aggregated.

Individual production processes are not within the realm of official statistics and thus observed data for various production technologies do not really exist. Economic statistics deal with transactions and not so much with technical transformations. Furthermore any relevant technology description should comprise the type of capital and labour used in the production process and the intermediate inputs. In the discussion on how symmetric input-output tables can be compiled, the term *technology* is a broader concept than in its usual sense.

The real task confronting the input-output compiler is to reorganise and to a certain extent further break down already highly aggregated data when working on the supply and use tables, and subsequently to deal in an appropriate way with a further *aggregation problem* when constructing the symmetric input-output table. From this point of view theories of optimal aggregation may be considered as relevant as those on production functions.

The terminological problems related to the term "technology" are closely related to a similar problem with the term "homogeneous" for products or units. Thus the term "homogenous" is used for what is really meant to be "mutually exclusive" classes according to a certain classification. For products such classifications are possible at any level of aggregation, but this very weak "homogeneity" cannot underpin the far-reaching assumptions leading to the concept of "homogeneous" production processes.

Independently of the approach chosen, it is obvious that any single element in a symmetric input-output table represents a unique "basket of products". The measured degree of "heterogeneity" of contents of these baskets is closely related to the elementary or most detailed level of product that is identified. In most countries the supply and use tables are compiled for rather aggregated product groups, often not more than a few hundred groups, and a level of 2000-3000 groups is very detailed in an international context. Only when there are more product groups than industries in the supply and use tables and in the compilation of constant price tables is it possible to identify the variation in the basket along a row of the *use table*. In cases where very aggregated (and therefore usually inefficient) methods are used in the compilation system (both current and constant prices) will the resulting data on the surface seem to comply with the theoretical assumption about homogeneity, as all evidence to the contrary has been eliminated in the compilation process.

The most important prerequisite for the collection of basic statistics is the *business register* and the types of units it contains. In practice, KAUs are created differently in different countries, depending on whether they have been defined top-down (i.e. a relatively modest breakdown of institutional units) or bottom-up (i.e. as aggregations of all existing local production units). The latter case follows the definitions set out in the SNA 1993 and the ESA 1995, and leads to more precise activity classification than in the former.

Each KAU has its own unique institutional and organisational characteristics, which may influence the composition of its purchases as much as the underlying technical production processes do. Two KAUs producing identical products may have quite different input (purchase) structures, depending on the degree of reliance on purchase of semi-fabricated products, outsourcing of certain activities, whether it owns its capital equipment and buildings rather than leasing or renting them etc, and in general on the degree of vertical integration of the various production processes.

For the proper understanding of the character of input-output data it is essential to realise that there is no way to eliminate completely the *institutional characteristics* of an economy from supply and use tables or symmetric input-output table. As institutional arrangements change over time in individual countries and may vary considerably across countries it is obvious that the interpretation of an input-output table as a description of a technical production system has serious limitations.

Statistically the KAUs represent the maximum elimination of institutional arrangements that can be obtained. These units are designed precisely for this purpose, and there are no official statistics for cost structures below this level. If basic statistics in a country only pertain to legal or institutional units, or top-down defined KAUs that come very close to legal units, there are no mathematical methods available that can disentangle this data set to have the columns relate to proper KAUs, and even less to product groups. In this case there are basically two possibilities. First, the compilers of the supply and use tables must work with the most detailed data available, and possibly conduct a few targeted surveys to break down the most complicated legal units into their constituent KAUs (i.e. extended use of the two-step process outlined below). The second possibility is to construct a rather inferior set of input-output tables by mathematical methods and assumptions alone.

11.7.4 Implications of the split between domestic output and imports

In the supply and use tables and the symmetric input-output tables, domestic output and imports of products belonging to the same product group are lumped together. In analytical uses there is often an interest in making a distinction between effects on the domestic economy and on imports. In order to facilitate this, the elements in the supply and use tables and the symmetric input-output tables must be separated into domestic products and imported products. This breakdown should be made at the most detailed product level possible, and thus preferably take place in the rectangular supply table.

When the split between domestic production and imports is made by assuming constant import ratios along the row (except for exports where actual information is usually available) the market share assumption used is similar to the assumption of fixed product sales structures. The resulting "domestic" and "import" matrices are very sensitive to the level of product aggregation at which the split has taken place. Thus the resulting matrices form a split at a detailed supply and use level will better reflect reality than those obtained if the split is carried out at the level of the (aggregated) square use matrix. No matter which methods are used in the construction of the symmetric input-output tables, the split between domestic output and imports is often based on the market share assumption.

11.7.5 Compilation of input-output tables in practice

When input-output statistics are compiled in practice, it is essential to take into account the desired properties and compilation methods of the symmetric input-output tables already in the work with the supply and use tables. By making appropriate choices of the groupings and structure of the supply and use tables it is possible to construct a data base which is relevant and useful in the current national accounts and at the same time can be transformed into a symmetric input-output table with a minimum of data manipulation.

Basically the compilation of the industry-by-industry symmetric input-output tables from the supply and use tables on the assumption of fixed product sales structures is quite straightforward as outlined above (subdivision and addition of rows). There is no need for any detour into theoretical production functions or mathematical exercises to construct the symmetric input-output tables. Formally the procedure of subdivision and addition is a matrix multiplication, but it can be of interest to watch the various steps in the calculation.

However, the industry-by-industry input-output table based on the assumption of a fixed product sales structure does not appear to be invariant of the technology assumption when it is used for impact analysis (Avonds 2007).

There are, however, some procedures related to the construction of the supply and use tables that are useful to observe before the transformation to the symmetric input-output tables takes place. Formally this is the first step of the *two-step process* which is applied by countries with extensive experience in producing and using input-output tables. There is no alternative standard approach that is widely used, but many country-specific variants or methods, especially for countries with only enterprise units in their economic statistics. Some of these represent special cases of the two-step process. In France, for example, the first step is carried to such an extreme that the supply matrix becomes diagonal. The second step is thus superfluous.

The first step of the *two-step process* or *redefinition process* consists basically of defining the industries in the supply and use tables (and in the activity tables of the national accounts in general) in such a way that no industries have secondary production in other *tabulation categories* (i.e. broad industry groups such as agriculture, fishing, mining, manufacturing, construction etc). If the KAUs for which statistics are available do not automatically fulfil this condition, it is the task of the national accountants to make further breakdowns (create new KAUs) until this condition is fulfilled, both for horizontally and vertically integrated units. Such additional breakdowns are typically made manually based on the best available information and judgement of the national accountants. As there is most often no specified intermediate consumption data available for these types of created KAUs, the redefinition can be implemented just by moving some parts of the totals for intermediate consumption between industries, thus also greatly facilitating the subsequent compilation of the detailed input structures in the supply table.

There are two important points to be noted concerning this procedure:

Firstly this redefinition reflects basically only *compliance with the SNA 1993* (and the ESA1995) concerning the definition of establishments (SNA 1993 par. 5.30-5.34). The compliance with the SNA definition of industries is essential for the usefulness of the data classified by activity not only for input-output purposes, but also for their analytical relevance in general. Industries should therefore ideally be defined in the same way in the activity tables of the national accounts, in the supply and use tables, and in the input-output tables.

Secondly, this method should not be seen as representing a "mixed technology" assumption, as defined in the old SNA of 1968. The first step is only to ascertain that the basic principles for compiling activity tables according to the SNA (and the ESA) are being followed. In the second step symmetric industry-by-industry tables are complied on the assumption of fixed product sales structures (fixed market shares).

The redefinition procedure will mainly relate to such activities as agriculture, energy, construction and trade. Though these breakdowns and reclassifications could be seen as the use of a product technology assumption, this is only true in a more general meaning of this term, as the input structures are not identified by means of multiplication with the inverse of the supply matrix, nor can they result in negative elements. And often very specific input structures that could not possibly be identified alone from the supply and use matrices are used in the redefinitions.

As this redefinition takes place before the intermediate part of the supply and use tables is filled in, it is often not even necessary to assume a specific input structure for the redefined output, as the transfers only take place between output and input totals of the industries. This facilitates the compilation of the supply and use tables. If for example all construction has a priory been transferred to the construction industry there will be no need to distribute construction materials to practically all industries in the supply and use tables – a procedure which would be both very time consuming and unreliable as source data for such input would usually be lacking.

For some activities this redefinition should already for other reasons have taken place. Thus the European System of Agricultural Accounts assumes that all agricultural activity is covered by the accounts, and there are very limited possibilities to retain non-agricultural secondary production within the system. All dwellings are assumed to be groups together in one industry. Trade activities outside the trade industries must already have been separately identified, as only the trade margins and not the gross turnover of the traded products should be counted as output.

The redefined industries become "pure" in the sense that they have no secondary production, and that all secondary output of these products have been transferred to the redefined industries. But the redefined industries are not homogeneous in any strict meaning of this term, as they may still produce many different products with separate input structures, price movements and distributions by users.

In some countries the business registers do not contain much detail on KAUs, but concentrate on enterprise units. In general data problems do, however, not exempt those compiling the national accounts from complying with the SNA/ESA rules. Experience shows that in cases where the starting point is a SUT with enterprise defined activities, and product-by-product tables are calculated on the assumption of a product technology, the successive rounds of recalculations (using the negatives as indicators) lead to changes to the original supply and use tables that basically (at least for changes related to the elimination of the big negatives) reflect the type of redefinitions described in the first step of the two-step process. In such cases it is a much more straightforward and efficient work process first to do the homework on the supply and use tables in a systematic way, as the negatives have a low signal value, and may lead to unsystematic and arbitrary adjustments in the elements of the supply and use matrices.

If the national accounts and thus also the supply and use tables are based on enterprise type units it may not be realistic to ask for supply and use tables where the industrial classification does not comply with the national accounts tables. When it comes to the construction of the symmetric input-output tables it is, however, perfectly possible to use the two step process, and first adjust the (rectangular) supply and use tables as outlined above, and subsequently compile an industry-by-industry symmetric input-output table based on the assumption of fixed product sales structures, without first having to aggregate to square supply and use matrices. Even though the comparability of the classifications for input-output tables and national accounts will not be perfect, the advantages of limited aggregation loss of information as well as the simplicity of the method will still be obtained.

However, the simplicity of the approach ignores that large negatives give an indication for a mismatch of the underlying sources, classifications and subsequent procedures and assumptions. It is an easy approach which does not guarantee that the supply and use system is balanced with the same priority for consistent estimates on the supply and demand side.

11.8 Transformation models

Before we discuss the main models for the transformation of supply and use tables to symmetric input-output tables, the input-output framework is introduced which will be used for the transformation.

11.8.1 Input-output framework

The input-output framework with a definition of variables is presented in Table 11.26. To keep the framework as simple as possible no distinction is made at this stage between domestic output and imports.

The information contained in the supply and use tables can be rearranged schematically in the input-output framework below. This framework was already introduced in the SNA 1968 (United Nations 1968, p. 48). In the tables of the input-output framework, the capital letters denote matrices and the small letters vectors. Transpose matrices are written as matrices with the attachment of a superscript (T). Vectors are written as column vectors and row vectors are written as transposed column vectors by the attachment of a superscript (T). The benefit of the input-output framework is that all information of supply and use tables and input-output tables can be integrated in one matrix.

The first row and column of the integrated input-output framework refer to products. The first row shows the use of products as intermediate output by industries (the elements of U) and final demand (elements of Y). The matrix U has products in the rows and industries in the columns.

The typical element of the matrix, for example in rows i and column j, represents the amount of product i used up in the production of industry j. The row sums of this matrix represent the total intermediate use of the various products in production. The column sums represent the intermediate use of all products by the various industries. The matrix Y has again products in the rows and final demand categories in the columns. Each element of the corresponding summation vector represents the net final use of a particular product for consumption, capital formation and net exports.

Since imports have been deducted in matrix Y, the first column of the integrated input-output framework shows the sources of products in the various domestic industries. The matrix V has industries in the rows and products in the columns. Its typical element for example in row j and column i, represents the production of product i by industry j. This matrix is strongly diagonal because the overwhelming proportion of the output of most industries consists of the own characteristic products (primary production). However, the matrix is not strictly diagonal, because many industries have a certain amount of secondary production. The column vector q at the end of the first row has as elements the domestic output of each of the products. This vector is repeated in transposed form as a row vector at the bottom of the first column.

The second row and column of the integrated input-output framework relate to industries. Whereas the column sums of V give the domestic output of the various products, the row sums of V give the domestic output of the various industries. These row totals are the elements of the vector of industry outputs (g). The column totals are the elements of the transposed vector of industry output (g^T). The second column of the integrated input-output framework shows the total costs to produce the industry outputs. The column sums of U, which represent the cost of intermediate inputs, and the elements of the row vector W, which represent the cost of primary input (value added) determine the value of industry output.

The final row and column relate to total input and output of products and industries, but also to total value of value added and net final expenditures. The system is balanced if total input of products (q^T) equals total output of products (q) and total input of industries (g^T) equals total output of industries (g). If this is the case, total value added (w) equals total net final expenditure (y).

Supply and use tables can be transformed to input-output tables in many ways. In general, rectangular supply and use tables can also be transformed to rectangular input-output tables. One could say a rectangular use table is already a product-by-industry input-output table with many more products than industries. This information can be transformed to rectangular use tables for products and homogeneous units of production (branches).

It is more common to transform supply and use tables into symmetric input-output tables. It is typical for symmetric input-output tables that total input always equals total output for a given column and row of products or industries. To avoid confusion with the transformation models, different letters have been used to identify for the different variables of symmetric product-by-product input-output tables and symmetric industry-by-industry input-output tables.

11.8.2 The main transformation models

The basic models for the transformation of supply and use tables to symmetric input-output tables are:

- Model A: Product-by-product input-output table based on product technology assumption
  Each product is produced in its own specific way, irrespective of the industry where it is produced.
- Model B: Product-by-product input-output table based on industry technology assumption
  Each industry has its own specific way of production, irrespective of its product mix.
- Model C: Industry-by-industry input-output table based on fixed industry sales structure assumption
  Each industry has its own specific sales structure, irrespective of its product mix.
- Model D: Industry-by-industry input-output table based on fixed product sales structure assumption
  Each product has its own specific sales structure, irrespective of the industry where it is produced.
- Model E: Product-by-product input-output tables based on hybrid technology assumption
- Model F: Product-by-product input-output tables based on Almon procedure

Table 11.26: Input-output framework

Supply table

	Industries	Supply
Products	V^T	q
Output	g^T	

Use table

	Industries	Final demand	Use
Products	U	Y	q
Value added	W		w
Output	g^T	y	

Integrated input-output framework

	Products	Industries	Final demand	Total
Products		U	Y	q
Industries	V			g
Value added		W		w
Total	q^T	g^T	y	

Input-output table - product by product

	Products	Final demand	Output
Products	S	Y	q
Value added	E		w
Input	q^T	y	

Input-output table - industry by industry

	Industries	Final demand	Output
Industries	B	F	g
Value added	W		w
Input	g^T	y	

LEGEND

V = Make matrix - transpose of supply matrix (industry by product)
V^T = Supply matrix (product by industry)
U = Use matrix for intermediates (product by industry)
Y = Final demand matrix (product by category)
F = Final demand matrix (industry by category)
S = Matrix for intermediates (product by product)
B = Matrix for intermediates (industry by industry)
E = Value added matrix (components by homogenous branches)
W = Value added matrix (components by industry)
diag(q) = Diagonal matrix of product output
diag(g) = Diagonal matrix of industry output

y = Vector of final demand
w = Vector of value added
I = Unit matrix
q = Column vector of product output
q^T = Row vector of product output
g = Column vector of industry output
g^T = Column vector of industry output

INPUT COEFFICIENTS OF USE TABLE

Z = U * inv(diag(g)) Input requirements for products per unit of output of an industry (intermediates)
L = W * inv(diag(g)) Input requirements for value added per unit of output of an industry (primary input)

MARKET SHARE COEFFICIENTS OF SUPPLY TABLE

C = V^T * inv(diag(g)) Product-mix matrix (share of each product in output of an industry)
D = V * inv(diag(q)) Market shares matrix (contrbution of each industry to the output of a product)

Table 11.27: Transformation models

I. BASIC TRANSFORMATIONS OF SUPPLY AND USE TABLES TO INPUT-OUTPUT TABLES

Model with market share coefficients		*Model with transformation coefficients*	
Model A: Product-by-product input-output table based on product technology assumption			Negatives
Each product is produced in its own specific way, irrespective of the industry where it is produced.			
$T = inv(V^T) * diag(q)$	Transformation matrix	$T = inv(V^T) * diag(q)$	
$A = Z * inv(C)$	Input coefficients intermediates	$A = U * T * inv((diag(q))$	
$R = L * inv(C)$	Input coefficients value added	$R = W * inv(V^T)$	
$q = inv[I - Z * inv(C)] * y$	Output	$q = inv(I - A) * y$	
$S = Z * inv(C) * diag(q)$	Intermediates	$S = U * T$	
$E = L * inv(C) * diag(q)$	Value added	$E = W * T$	
$Y = Y$	Final demand	$Y = Y$	
Model B: Product-by-product input-output table based on industry technology assumption			No negatives
Each industry has its own specific way of production, irrespective of its product mix.			
$T = inv(diag(g)) * V$	Transformation matrix	$T = inv(diag(g)) * V$	
$A = Z * D$	Input coefficients intermediates	$A = U * T * inv[diag (q)]$	
$R = L * D$	Input coefficients value added	$R = W * T * diag (q)$	
$q = inv(I - Z * D) * y$	Output	$q = inv(I - A) * y$	
$S = Z * D * diag(q)$	Intermediates	$S = U * T$	
$E = L * D * diag(q)$	Value added	$E = W * T$	
$Y = Y$	Final demand	$Y = Y$	
Model C: Industry-by-industry input-output table based on fixed industry sales structure assumption			Negatives
Each industry has its own specific sales structure, irrespective of its product mix.			
$T = inv(C)$	Transformation matrix	$T = diag(g) * inv(V^T)$	
$A = inv(C) * Z$	Input coefficients intermediates	$A = T * U * inv[diag (g)]$	
$R = W * inv[diag (q)]$	Input coefficients value added	$R = W * inv[diag (g)]$	
$g = inv(I - inv(C) * Z) * inv(C) * y$	Output	$g = inv[I - T * U * inv(diag(g))] * T * y$	
$B = inv(C) * Z * diag(g)$	Intermediates	$B = T * U$	
$W = W$	Value added	$W = W$	
$F = inv(C) * Y$	Final demand	$F = T * Y$	
Model D: Industry-by-industry input-output table based on fixed product sales structure assumption			No negatives
Each product has its own specific sales structure, irrespective of the industry where it is produced.			
$T = D$	Transformation matrix	$T = V * inv(diag(q))$	
$A = D * Z$	Input coefficients intermediates	$A = T * U * inv[diag (g)]$	
$R = W * inv[diag (g)]$	Input coefficients value added	$R = W * inv[diag (g)]$	
$g = inv(I - D *Z) * D * y$	Output	$g = inv[I - T * U * inv(diag(g))] * T * y$	
$B = D * Z * diag(g)$	Intermediates	$B = T * U$	
$W = W$	Value added	$W = W$	
$F = D * Y$	Final Demand	$F = T * Y$	

II. OTHER TRANSFORMATIONS OF SUPPLY AND USE TABLES TO INPUT-OUTPUT TABLES

Model E: Product-by-product input-output tables based on hybrid technology assumption		No negatives
$V_1 = V \# H$	Matrix for product technology	
$V_2 = V - V_1$	Matrix for industry technology	
$C_1 = V_1^T * inv(diag(g_1))$	Product mix matrix for product technology	
$D_2 = V_2 * inv(diag(q))$	Market share matrix for hybrid technology	
$R = inv(C_1) * (I-diag(D_2^T * i)) + D_2$	Hybrid technology transformation matrix	
$A = Z * R$	Input coefficients intermediates	
$R = L * R$	Input coefficients value added	
$q = inv(I - Z * R) * y$	Output	
$S = Z * R * diag(q)$	Intermediates	
$y = y$	Final Demand	
$E = L * R * diag(q)$	Value added	

V_1 = Matrix for product technology
V_2 = Matrix for indusytry technology ($V - V_1$)
g_1 = Vector of industry output with product technology
i = Unit vector
H = Matrix for hybrid technology

Model F: Product-by-product input-output tables based on Almon procedure	No negatives
See special documentation in Box 11.4 and Box 11.7.	

The main transformation models are presented in Table 11.27. For the convenience of the user, two versions of the transformations models are presented vertically in the summary sheet. The first version is based on market share coefficients while the second version refers to transformation coefficients.

Box 11.7: Almon's algorithm

We assume that U and V are square.

1. Calculate the market shares matrix (contribution of each industry to the output of a product):

$$M = V(\hat{q})^{-1}$$

2. Calculate the first approximation of the input-output table:

$$Z^{(0)} = U$$

3. For each row i:
   a. For each column j:
      i. Estimate the total amount of good j that is used by industry i for secondary production:

$$c_{ij}^{(k)} = \sum_{\substack{h=1 \\ h \neq j}}^{n} m_{jh} z_{ih}^{(k)}$$

      ii. If $c_{ij} > u_{ij}$ calculate the scale down factor:

$$s_{ij}^{(k)} = \frac{u_{ij}}{c_{ij}^{(k)}}$$

      Otherwise set the scale factor $s_{ij}^{(k)}$ to 1.

      iii. Make a new estimation of z_{ij}, by taking u_{ij}, subtracting the units used for making other products than product i in industry i and adding the units used for making product i in other industries than industry i:

$$z_{ij}^{(k+1)} = u_{ij} - s_{ij}^{(k)} c_{ij}^{(k)} + \sum_{\substack{h=1 \\ h \neq j}}^{n} s_{ih}^{(k)} m_{hj} z_{ij}^{(k)}$$

   b. Repeat step (a) until for all j is within the desired precision.
4. Perform step 2 and 3 for K and Y (the value-added part of the matrix).

Note that also a row with subsidies may be a part of the supply table. Of course, a subsidy row only contains negatives and therefore should not be scaled down. For these rows, in step ii the scale down factor always has to be set to 1.

Basic transformation models for product-by-product input-output tables

To arrive at product-by-product input-output tables the values along the columns of the use matrix are post-multiplied with specific transformation matrices.

- In Model A (Product technology) the transformation of the values along the columns of the use matrix can be expressed as the post-multiplication of the use matrix with a transformation matrix. The transformation matrix reflects the product-mix of an industry.
- In Model B (Industry technology) the transformation of the values along the columns of the use matrix is compiled by post-multiplying the use matrix with a different transformation matrix. In this case the transformation matrix incorporates the contribution of each industry to the output of a product.

Basic transformation models for industry-by-industry input-output tables

For industry-by-industry input-output tables the values along the columns of the use matrix are pre-multiplied with specific transformation matrices.

- In Model C (Fixed industry sales structure) the transformation of the values along the columns of the use matrix is compiled by pre-multiplying the use matrix with a transformation matrix. In this case the transformation matrix incorporates the contribution of each industry to the output of a product. The transformation matrix reflects the market shares matrix.
- In Model D (Fixed product sales structure) the transformation of the values along the columns of the use matrix can be expressed as the pre-multiplication of the use matrix with a transformation matrix. The transformation matrix reflects the inverse of the product-mix of an industry.

Other transformation models for product-by-product input-output tables

National Statistical Offices use two other types of transformation models to compile symmetric product-by-product input-output tables.

- Model E (Hybrid technology) is a variation of Model A and Model B. In the case of the hybrid model the supply table (V) is separated into two different supply tables reflecting the product technology (V_1) and the industry technology (V_2). Then the two model types are merged to a hybrid transformation model.
- Model F (Almon procedure) is based on the matrix multiplication from the product technology model as described in Model A. However Almon does not calculate this multiplication directly, but replaces the matrix multiplication by successive approximations to calculate the symmetric input-output tables. Almon adapts the approximations in a way that it is certain to avoid negative flows yet keeps close to the spirit of the product technology idea.

Table 11.28: Summary of transformation models

	MODEL A Product technology Product-by-product input-output table	MODEL B Industry technology Product-by-product input-output table	MODEL C Fixed industry sales structure Industry-by-industry input-output table	MODEL D Fixed product sales structure Industry-by-industry input-output table
Transformation matrix	T = inv(V') * diag(q)	T = inv[diag(g)] * V	T = diag(g) * inv(V')	T = V * inv[diag(q)]
Input coefficients	A = U * T * inv[diag(q)]	A = U * T * inv[diag (q)]	A = T * U * inv[diag (g)]	A = T * U * inv[diag (g)]
Intermediates	S = U * T	S = U * T	B = T * U	B = T * U
Value added	E = W * T	E = W * T	W = W	W = W
Final demand	Y = Y	Y = Y	F = T * Y	F = T * Y
Output	q = inv(I - A) * y	q = inv(I - A) * y	g = inv(I - A) * y	g = inv(I - A) * y

The main formulas of the four basic transformation models are summarised in Table 11.28. From this tabulation it becomes clear that the four basic models have some dual features. Product-by-product input-output tables are compiled by post-multiplying the use matrix and value added matrix with a transformation matrix reflecting either product technology or industry technology.

Industry-by-industry input-output tables can be derived from the supply and use system by pre-multiplying the use matrix and final use matrix with a transformation matrix reflecting either the fixed industry sales structure or fixed product sales structure.

Reverse transformation

For some EU countries input-output tables are available, rather than supply and use tables. This is in particular true for historical input-output tables. If one wishes to establish long time series of supply and use tables, these selected input-output tables need to be “reverse-engineered” by transforming input-output tables backward into the corresponding supply and use tables.

Table 11.29: Transformation of supply and use tables to input-output tables and vice versa

I. TRANSFORMATION OF SUPPLY AND USE TABLES TO INPUT-OUTPUT TABLES		
Model A: Transformation of supply and use tables to product-by-product input-output table based on product technology assumption		Negatives
S = Z * inv(C) * diag(q) E = L * inv(C) * diag(q) Y = Y	Intermediates Value added Final demand	
Model B: Transformation of supply and use tables to product-by-product input-output table based on industry technology assumption		No negatives
S = Z * D * diag(q) E = L * D * diag(q) Y = Y	Intermediates Value added Final demand	
Model C: Transformation of supply and use tables to industry-by-industry input-output table based on fixed industry sales structure assumption		Negatives
B = inv(C) * Z * diag(g) W = W F = inv(C) * Y	Intermediates Value added Final demand	
Model D: Transformation of supply and use tables to industry-by-industry input-output table based on fixed product sales structure assumption		No negatives
B = D * Z * diag(g) W = W F = D * Y	Intermediates Value added Final Demand	
II. TRANSFORMATION OF INPUT-OUTPUT TABLES TO SUPPLY AND USE TABLES		
Reverse Model A: Transformation of product-by-product input-output table based on product technology assumption to use table		No negatives
U = S * inv((diag(q)) * C * diag(g) W = E * inv((diag(q)) * C * diag(g) Y = Y	Intermediates Value added Final demand	
Reverse Model B: Transformation of product-by-product input-output table based on industry technology assumption to use table		Negatives
U = S * inv((diag(q)) * inv(D) * diag(g) W = E * inv((diag(q)) * inv(D) * diag(g) Y = Y	Intermediates Value added Final demand	
Reverse Model C: Transformation of industry-by-industry input-output table based on fixed industry sales structure assumption		No negatives
U = C * B W = W Y = C * F	Intermediates Value added Final demand	
Reverse Model D: Transformation of industry-by-industry input-output table based on fixed product sales structure assumption		Negatives
U = inv(D) * B W = W Y = inv(D) * F	Intermediates Value added Final demand	

LEGEND
S = Matrix for intermediate consumption of products (product by product)
Z = Input requirements for products per unit of output of an industry (use table)
C = Product-mix matrix with share of each product in output of an industry (supply table)
q = Vector of product output
E = Value added matrix (component by homgeneous branches)
L = Input requirements for value added per unit of output of an industry (use table)
Y = Final demand matrix (product by category)
D = Market shares matrix with contrbution of each industry to the output of a product (supply table)
B = Matrix for intermediate consumption of products (industry by industry)
g = Vector of industry output
W = Value added matrix (component by industry)
F = Final demand matrix (industry by category)
U = Use matrix for intermediate consumption of products (use table)

For the transformation of input-output tables to the corresponding supply and use tables information on the product mix (C coefficients) or market shares (D coefficients) of the supply table and a product-by-product input-output table or an industry-by-industry input-output table are required. In practice, at least a supply table of a base year is essential for the transformation of an input-output table to supply and use tables. In Table 11.29 the four basic models for the transformation of supply and use tables to input-output tables and their corresponding reverse models for the transformation of input-output tables to supply and use tables are presented.

It is interesting to notice the dual character of the transformation models.

- Depending on the structure of the supply table, the transformation of supply and use tables to input-output tables with Model A and Model C may generate negative entries in the input-output table. However, the reverse transformation of input-output tables to supply and use tables with the Reverse Model A and the Reverse Model C will not result in negative entries.
- The transformation of supply and use tables to input-output tables.with Model B and Model D will not generate negative entries in the input-output table. However, the reverse transformation of input-output tables to supply and use tables with the Reverse Model B and the Reverse Model D may generate negative entries depending on the structure of the supply table.

From this observation it can be concluded that implausible negative entries in the derived tables may result if the matrix C (Product-mix matrix) or the matrix D (Market share matrix) have to be inverted in the course of the transformation.

11.8.3 The transformation models with domestic output and imports

For empirical research it is very important to make a distinction between domestic output and imports in the supply and use framework. In Table 11.30 the input-output framework is refined by separating domestic products from imported products.

To have a better overview, the use table of imports is integrated in the use table of domestic output. Normally, only the last row vector of the import matrix with the total level of imports is shown in the use table of domestic output. The same way of presentation has been chosen for the derived product-by-product and industry-by-industry input-output tables.

The following documentation explains the structure of the four general transformation models in more detail. The following legend defines the variables which are used in the transformation.

U	Intermediate part of the use table in the dimension product by industry
W	Value added part of the use table in the dimension value added by industry
Y	Final demand part of the use table in the dimension product by final demand
V’	Supply table excluding the columns for imports in the dimension product by industry
$(V')^{-1}$:	Inverse of V
S	Transformed intermediate part of use table for symmetric product-by-product input-output table
B	Transformed intermediate part of use table for symmetric industry-by-industry input-output table
E	Transformed value added part of use table for symmetric product-by-product input-output table
F	Transformed final demand part of use table for symmetric industry-by-industry input-output table
A	Input coefficients matrix for intermediates of the product-by-product input-output table or industry-by-industry input-output table
R	Input coefficients matrix for value added of the product-by-product input-output table or industry-by-industry input-output table
q	Vector of total supply of products
m	Vector of imports by product
q-m	Vector of total domestic output of products
diag(q-m)	Matrix with q-m on the diagonal
g	Vector of total output of industries
diag(g)	Matrix with g on the diagonal

Table 11.30: Input-output framework for domestic output and imports

Supply table

	Industries	Output	Imports	Supply
Products	V^T	q-m	m	q
Output	g^T			

Use table of domestic output

	Industries	Final demand	Use
Domestic products	U_d	Y_d	q-m
Imported products	U_m	Y_m	m
Value added	W		w
Output	g^T	y	

Integrated input-output framework

	Domestic products	Imported products	Industries	Final demand	Total
Domestic products			U_d	Y_d	q-m
Imported products			U_m	Y_m	m
Industries	V				g
Value added			W		w
Total	$(q-m)^T$	m^T	g^T	y	

Input-output table of domestic output - product by product

	Products	Final demand	Use
Domestic products	S_d	Y_d	q-m
Imported products	S_m	Y_m	m
Value added	E		w
Output	$(q-m)^T$	y	

Input-output table of domestic output - industry by industry

	Industries	Final demand	Output
Domestic industries	B_d	F_d	g
Imports from industries	B_m	F_m	m
Value added	W		w
Output	g^T	y	

LEGEND

V = Make matrix - transpose of supply matrix (industry by product)
V^T = Supply matrix (product by industry)
U = Use matrix for intermediates (product by industry)
Y = Final demand matrix (product by category)
F = Final demand matrix (industry by category)
S = Matrix for intermediates (product by product)
B = Matrix for intermediates (industry by industry)
E = Value added matrix (components by homogenous branches)
W = Value added matrix (components by industry)
diag(q-m) = Diagonal matrix of product output from domestic production
diag(g) = Diagonal matrix of industry output

y = Vector of final demand
w = Vector of value added
I = Unit matrix
q-m = Column vector of product output
$(q-m)^T$ = Row vector of product output
g = Column vector of industry output
g^T = Column vector of industry output
m = vector of total imports by product
m^T = Row vector of imports
^{d} = Index for domestic
^{m} = Index for imported

INPUT COEFFICIENTS OF USE TABLE

Z = U * inv(diag(g)) Input requirements for products per unit of output of an industry (intermediates)
L = W * inv(diag(g)) Input requirements for value added per unit of output of an industry (primary input)

MARKET SHARE COEFFICIENTS OF SUPPLY TABLE

C = V^T * inv(diag(g)) Product-mix matrix (share of each product in output of an industry)
D = V * inv(diag(q-m)) Market shares matrix (contrbution of each industry to the output of a product)

Mathematical formulation of the product technology assumption (Model A)

Mathematically, a transformation of values along the columns of a matrix can be expressed as the post-multiplication of the matrix with a transformation matrix. In the case of the product technology assumption, the reader may verify that the transformation matrix is equal to:

$T = (V')^{-1}\mathrm{diag}(q-m)$

Hence intermediates and value added of the product-by-product input-output table are:

$S = UT$
$E = WT$

Input coefficient matrices can be derived from those by dividing the columns by the total domestic output of products.

$A = S(\mathrm{diag}(q-m))^{-1} = UT(\mathrm{diag}(q-m))^{-1} = U(V')^{-1}$
$R = E\,(\mathrm{diag}(q-m))^{-1} = W\,T(\mathrm{diag}(q-m))^{-1} = W(V')^{-1}$

From these equations follows:

$U = AV'$
$W = RV'$

which is the equation formulated as

Use table = Input coefficient matrix * Supply table

in this chapter. It was argued that in practice this formula will not hold exactly, but we would have instead

Use table = Input coefficient matrix * Supply table + Difference matrix

This can be written in mathematical form as

$U = AV' + \Sigma_{int}$
$W = RV' + \Sigma_{va}$

Mathematical formulation of the industry technology assumption (Model B)

In the case of the industry technology, the transformation matrix is:

$T = (\mathrm{diag}(g))^{-1}V$

Hence intermediates and value added of the product-by-product input-output table are:

$S = UT$
$W = WT$

Input coefficient matrices can be derived from those by dividing the columns by the total domestic output of products.

$A = S(\mathrm{diag}(q-m))^{-1} = U(\mathrm{diag}(g))^{-1}\,V(\mathrm{diag}(q-m))^{-1} = ZD$
$R = E(\mathrm{diag}(q-m))^{-1} = W(\mathrm{diag}(g))^{-1}\,V(\mathrm{diag}(q-m))^{-1} = LD$

With

$Z = U(\mathrm{diag}(g))^{-1}$	Matrix of industry intermediate input coefficients
$L = W(\mathrm{diag}(g))^{-1}$	Matrix of industry value added coefficients
$D = V(\mathrm{diag}(q-m))^{-1}$	Matrix of market shares

Mathematical formulation of the assumption of fixed industry sales structures (Model C)

In the case of the fixed product sales structures model, the transformation matrix is:

$T = diag(g)(V')^{-1}$.

Hence intermediates and final demand of the industry-by-industry input-output table are:

$B = T\,U$
$F = T\,Y$

Coefficient matrices can be derived by dividing the columns by the total outputs of industries.

$A = B(diag(g))^{-1}$
$R = W(diag(g))^{-1}$

Mathematical formulation of the assumption of fixed product sales structures (Model D)

In the case of the fixed product sales structures model, the transformation matrix is:

$T = V(diag(q\text{-}m))^{-1}$.

Hence intermediates and final demand of the industry-by-industry input-output table are:

$B = T\,U$
$F = TY$

Input coefficient matrices can be derived by dividing the columns by the total outputs of industries.

$A = B(diag(g))^{-1} = DZ$
$R = W(diag(g))^{-1}$

With

$Z = U(diag(g))^{-1}$	Matrix of industry intermediate input coefficients
$L = W(diag(g))^{-1}$	Matrix of industry value added coefficients
$D = V(diag(q\text{-}m))^{-1}$	Matrix of market shares

Making the split between use of domestically produced and imported products in the product technology model

Suppose we have available the following tables

U^d	Use table of domestic intermediates in the dimension product by industry
U^m	Use table of imported intermediates in the dimension product by industry

With $U = U^d + U^m$.

We want to calculate

S^d	Domestic intermediates for the product-by-product input-output table
S^m	Imported intermediates for the product-by-product input-output table

with $S = S^d + S^m$.

We have also $U = AV' + \Sigma_{int}$ since we are working in the product technology framework.

We will use the following assumption: for each product i, the ratio u_{ik}^m/u_{ik} is fixed for all outputs produced by industry k.

Using A and V' we can calculate the input of product i used in the production of product j in industry k:

$a_{ij}v'_{jk}$

With the above assumption we can calculate the use of imported products i in the production of product j in industry k:

$u_{ik}^m/u_{ik} * a_{ij}v'_{jk}$

If we aggregate over all industries, we will obtain the use of imported products i in the total production of product j:

$s_{ij}^m = \Sigma_k (u_{ik}^m/u_{ik} * a_{ij}v'_{jk})$

The row totals of Z^m should be equal to total intermediate use of imported products. However, this is only the case if the difference matrix (Σ_{int}) is zero, as can be shown as follows:

$\Sigma_j s_{ij}^m = \Sigma_j\Sigma_k (u_{ik}^m/u_{ik} * a_{ij}v'_{jk}) = \Sigma_k u_{ik}^m/u_{ik} \Sigma_j a_{ij}v'_{jk} = \Sigma_k u_{ik}^m/u_{ik} (u_{ik} - \varepsilon_{ik})$
If $\Sigma_{int} = 0$ then
$\Sigma_j s_{ij}^m = \Sigma_k u_{ik}^m/u_{ik} * u_{ik} = \Sigma_k u_{ik}^m$

If $\Sigma_{int} \neq 0$ (as in practice will be) these formulas will not yield a consistent breakdown of S in S^d and S^m. This can be prevented by using instead the following formula:

$s_{ij}^m = \Sigma_k (u_{ik}^m/(u_{ik} - \varepsilon_{ik}) * a_{ij}v'_{jk})$

Then, the import share is calculated on the basis of the actual import table U^m and the "New Use" matrix ($U - \Sigma_{int}$). If this formula is used, however, one should pay attention to inconsistencies between these two matrices. Extreme example: suppose $u_{ik} = 100$, of which 80 are imported. If for example $\varepsilon_{ik} = 30$, we will obtain the ratio 80/70 in the above formula, i.e. we assume that of 70 used inputs, 80 were imported. Therefore, before applying this formula, the tables need to be checked for such problems. When necessary, U^m should be adjusted in the direction of $U - \Sigma_{int}$.

If we define

$m_{ik} = u_{ik}^m/(u_{ik} - \varepsilon_{ik})$

we can rewrite the formula as

$z_{ij}^m = \Sigma_k m_{ik}a_{ij}v'_{jk}) = a_{ij} \Sigma_k m_{ik}v_{kj} = a_{ij}(MV)_{ij}$

This shows that this method is relatively easy to implement, since it consists of only one (normal) matrix multiplication plus one entry-by-entry matrix multiplication.

11.8.4 Numerical examples

In the following four tables numerical examples for the four basic models are given. To study the relations between supply and use and input and output, the examples consist of the supply and use tables and the derived symmetric input-output tables in one large table. Data were chosen on purpose for the supply and use system which do not generate negative flows in Model A and Model C. The examples for Model A and Model D were already introduced as Box 1.3 and Box 1.4 in Chapter 1 (The input-output framework in the 1995 ESA).

In Table 11.31 the supply and use system is presented separating domestic output and imports. Model A has been applied to compile symmetric product-by-product input-output tables. It is typical for product-by-product input-output tables that the total output by sector of the input-output table is equivalent with the total output of products in the supply and use tables. In the case of Model A it has been assumed that each product is produced in its own specific way, irrespective of the industry where it is produced. In other words, homogeneous technologies are used to produce a specific product disregarding which enterprise owns the establishment.

In Table 11.32 Model B has been applied to compile symmetric product-by-product input-output tables. In this case it is assumed that each industry has its own specific way of production irrespective of its product mix. The local kind-of-activity unit is defined as an enterprise in which the principal productive activity accounts for most of the value added.

However, in some countries the business registers do not contain kind-of-activity units (KAU) but only enterprise units. The available statistics will therefore mainly refer to enterprise units. In this case, industries have a more diversified structure and consequently the results for product-by-product input-output tables which were based on the product technology assumption and industry technology assumption will divert.

Supply and use tables comprise industries and homogenous inputs in terms of products and primary inputs for labour, capital and natural resources. Product-by-product input-output tables are defined for homogenous units of production (activities). The inputs are products and primary inputs which are employed for homogenous production units. Industry-by-industry input-output tables identify the input and output of industries. The input are bundles of products which are provided by industries and primary inputs employed by industries and the output again is a set of products which can be identified in the supply table.

In Table 11.33 symmetric industry-by-industry input-output tables are presented which were compiled with the fixed industry sales structure assumption of Model C. In this case, the input structures of industries determine the symmetric table. It should be noted that total final demand and total value added is the same as in the previous input-output tables, however, the distribution among industries is different from the allocation to products. In empirical research this model is hardly ever used.

Table 11.31: Product-by-product input-output tables based on the product technology assumption

Supply table

Industries / Products	Industries			Domestic production	Imports	Total supply
	Agriculture	Industry	Service activities			
Agricultural products	270	30	50	350	20	370
Industrial products	10	430	100	540	50	590
Services	20	40	550	610	30	640
Total	300	500	700	1 500	100	3 100

Use table of domestic output and imports

Industries / Products	Industries			Final uses			Uses
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Domestic output							
Agricultural products	30	50	140	80	20	30	350
Industrial products	90	100	70	120	100	60	540
Services	60	100	70	290	60	30	610
Imports	30	40	15	5	5	5	100
Value added	90	210	405	0	0	0	705
Output	300	500	700	495	185	125	
Imports							
Agricultural products	4	9	3	1	1	2	20
Industrial products	16	19	7	3	3	2	50
Services	10	12	5	1	1	1	30
Total	30	40	15	5	5	5	100

Product-by-product input-output tables based on product technology assumption (Model A)
Each product is produced in its own specific way, irrespective of the industry where it is produced.

Input-output table of domestic output and imports

Products / Products	Homogenous branches			Final uses			Uses
	Agricultural products	Industrial products	Services	Final consumption	Gross capital formation	Exports	
Input-output table of domestic output							
Agricultural products	31.77	47.81	140.42	80.00	20.00	30.00	350.00
Industrial products	112.44	110.42	37.14	120.00	100.00	60.00	540.00
Services	73.23	114.19	42.58	290.00	60.00	30.00	610.00
Imports	37.73	46.07	1.20	5.00	5.00	5.00	100.00
Value added	94.83	221.51	388.66	0.00	0.00	0.00	705.00
Output	350.00	540.00	610.00	495.00	185.00	125.00	
Input-output table of imports							
Agricultural products	4.91	10.75	0.34	1.00	1.00	2.00	20.00
Industrial products	20.22	21.68	0.11	3.00	3.00	2.00	50.00
Services	12.60	13.65	0.74	1.00	1.00	1.00	30.00
Total	37.73	46.07	1.20	5.00	5.00	5.00	100.00
Input-output table of supply and use							
Agricultural products	36.69	58.55	140.76	81.00	21.00	32.00	370.00
Industrial products	132.65	132.10	37.25	123.00	103.00	62.00	590.00
Services	85.83	127.84	43.33	291.00	61.00	31.00	640.00
Value added	94.83	221.51	388.66	0.00	0.00	0.00	705.00
Output	350.00	540.00	610.00	495.00	185.00	125.00	2305.00
Imports of similar products	20.00	50.00	30.00	0.00	0.00	0.00	100.00
Supply	370.00	590.00	640.00	495.00	185.00	125.00	

Quite in contrast to Model C, Model D is widely applied, notably in Denmark, Hungary, the Netherlands, and Finland, further in Canada and Norway. In Table 11.34 the corresponding results are presented for the numerical example. The transformation is based on the assumption that each product has its own specific sales structure, irrespective of the industry where it is produced. This assumption is plausible for a rectangular supply and use system with a great number of products. The more homogeneous a product actually is the easier it will be to determine the allocation of its uses.

Table 11.32: Product-by-product input-output tables based on the industry technology assumption

Supply table

Industries / Products	Industries			Domestic production	Imports	Total supply
	Agriculture	Industry	Service activities			
Agricultural products	270	30	50	350	20	370
Industrial products	10	430	100	540	50	590
Services	20	40	550	610	30	640
Total	300	500	700	1 500	100	3 100

Use table of domestic output

Industries / Products	Industries: Agriculture	Industry	Service activities	Final uses: Final consumption	Gross capital formation	Exports	Uses
Domestic output							
Agricultural products	30	50	140	80	20	30	350
Industrial products	90	100	70	120	100	60	540
Services	60	100	70	290	60	30	610
Imports	30	40	15	5	5	5	100
Value added	90	210	405	0	0	0	705
Output	300	500	700	495	185	125	
Imports							
Agricultural products	4	9	3	1	1	2	20
Industrial products	16	19	7	3	3	2	50
Services	10	12	5	1	1	1	30
Total	30	40	15	5	5	5	100

Product-by-product input-output tables based on industry technology assumption (Model B)
Each industry has its own specific way of production, irrespective of its product mix.

Input-output table of domestic output

Products / Products	Homogenous branches: Agricultural products	Industrial products	Services	Final uses: Final consumption	Gross capital formation	Exports	Uses
Input-output table of domestic output							
Agricultural products	40.00	64.00	116.00	80.00	20.00	30.00	350.00
Industrial products	92.00	99.00	69.00	120.00	100.00	60.00	540.00
Services	65.00	98.00	67.00	290.00	60.00	30.00	610.00
Imports	30.47	37.54	16.99	5.00	5.00	5.00	100.00
Value added	122.53	241.46	341.01	0.00	0.00	0.00	705.00
Output	350.00	540.00	610.00	495.00	185.00	125.00	
Input-output table of imports							
Agricultural products	4.35	8.30	3.34	1.00	1.00	2.00	20.00
Industrial products	16.04	17.87	8.09	3.00	3.00	2.00	50.00
Services	10.08	11.37	5.56	1.00	1.00	1.00	30.00
Total	30.47	37.54	16.99	5.00	5.00	5.00	100.00
Input-output table of supply and use							
Agricultural products	44.35	72.30	119.34	81.00	21.00	32.00	370.00
Industrial products	108.04	116.87	77.09	123.00	103.00	62.00	590.00
Services	75.08	109.37	72.56	291.00	61.00	31.00	640.00
Value added	122.53	241.46	341.01	0.00	0.00	0.00	705.00
Output	350.00	540.00	610.00	495.00	185.00	125.00	2305.00
Imports of similar products	20.00	50.00	30.00	0.00	0.00	0.00	100.00
Supply	370.00	590.00	640.00	495.00	185.00	125.00	

Model A and Model D are widely used in the compilation of input-output tables. The results of this small numerical example already reveal that the input-coefficients of the derived input-output tables in Table 11.30 and Table 11.34 are significantly different. It remains to be evaluated in empirical research which input structures reflect the real cost structures of producing goods and services.

Table 11.33: Industry-by-industry input-output tables based on the fixed industry sales structure assumption

Supply table

Products \ Industries	Industries			Domestic production	Imports	Total supply
	Agriculture	Industry	Service activities			
Agricultural products	270	30	50	350	20	370
Industrial products	10	430	100	540	50	590
Services	20	40	550	610	30	640
Total	300	500	700	1 500	100	3 100

Use table of domestic output

Products \ Industries	Industries			Final uses			Uses
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Domestic output							
Agricultural products	30	50	140	80	20	30	350
Industrial products	90	100	70	120	100	60	540
Services	60	100	70	290	60	30	610
Imports	30	40	15	5	5	5	100
Value added	90	210	405	0	0	0	705
	300	500	700	495	185	125	
Imports							
Agricultural products	4	9	3	1	1	2	20
Industrial products	16	19	7	3	3	2	50
Services	10	12	5	1	1	1	30
Total	30	40	15	5	5	5	100

Industry-by-industry input-output table based on fixed industry sales structure assumption (Model C)
Each industry has its own specific sales structure, irrespective of its product mix.

Input-output table of domestic output

Industries \ Industries	Industries			Final uses			Uses
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Input-output table of domestic output							
Agriculture	21.97	40.11	145.71	55.39	10.07	26.74	300.00
Industry	93.00	95.77	64.09	78.18	105.12	63.85	500.00
Services	65.03	114.12	70.20	356.43	64.81	29.41	700.00
Imports	30.00	40.00	15.00	5.00	5.00	5.00	100.00
Value added	90.00	210.00	405.00	0.00	0.00	0.00	705.00
Output	300.00	500.00	700.00	495.00	185.00	125.00	
Input-output table of imports							
Agriculture	2.47	7.69	2.43	0.82	0.82	2.01	16.24
Industry	16.71	19.70	7.14	3.31	3.31	2.10	52.28
Services	10.82	12.61	5.43	0.87	0.87	0.89	31.48
Total	30.00	40.00	15.00	5.00	5.00	5.00	100.00

Input-output table of supply and use							
Agriculture	24.44	47.80	148.14	56.21	10.89	28.75	316.24
Industry	109.71	115.47	71.23	81.49	108.44	65.95	552.28
Services	75.85	126.73	75.63	357.30	65.67	30.30	731.48
Value added	90.00	210.00	405.00	0.00	0.00	0.00	705.00
Output	300.00	500.00	700.00	495.00	185.00	125.00	2305.00
Imports of similar products	16.24	52.28	31.48	0.00	0.00	0.00	100.00
Supply	316.24	552.28	731.48	495.00	185.00	125.00	

Without valuation matrices a compilation of supply and use tables neither at purchasers' prices nor at basic prices is possible. Insofar the transformation of supply and use tables from purchasers' prices to basic prices is always an option. To properly deflate GDP, a transformation of the supply system from purchasers' prices to basic prices is recommended including a compilation of the use table of imports at basic prices. However, if supply and use tables at basic prices are available for domestic output and imports the transformation of the supply and use tables to symmetric industry-by-industry tables is a purely mechanical procedure. Insofar, the compilation of annual supply and use tables at basic prices and industry-by-industry input-output tables should be a standard option for a modern input-output data base. Depending on the resources the compilation of annual product-by-product input-output tables should also be part of the standard system.

Table 11.34: Industry-by-industry input-output tables based on the fixed product sales structure assumption

Supply table

Industries / Products	Industries			Domestic production	Imports	Total supply
	Agriculture	Industry	Service activities			
Agricultural products	270	30	50	350	20	370
Industrial products	10	430	100	540	50	590
Services	20	40	550	610	30	640
Total	300	500	700	1 500	100	3 100

Use table of domestic output

Industries / Products	Industries			Final uses			Uses
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Domestic output							
Agricultural products	30	50	140	80	20	30	350
Industrial products	90	100	70	120	100	60	540
Services	60	100	70	290	60	30	610
Imports	30	40	15	5	5	5	100
Value added	90	210	405	0	0	0	705
Output	300	500	700	495	185	125	
Imports							
Agricultural products	4	9	3	1	1	2	20
Industrial products	16	19	7	3	3	2	50
Services	10	12	5	1	1	1	30
Total	30	40	15	5	5	5	100

Industry-by-industry input-output tables based on fixed product sales structure assumption (Model D)
Each product has its own specific sales structure, irrespective of the industry where it is produced.

Input-output table of domestic production

Industries / Industries	Industries			Final uses			Uses
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Input-output table of domestic output							
Agriculture	26.78	43.70	111.59	73.44	19.25	25.24	300.00
Industry	78.17	90.47	72.33	121.43	85.28	52.32	500.00
Services	75.05	115.83	96.08	295.13	75.47	42.45	700.00
Imports	30.00	40.00	15.00	5.00	5.00	5.00	100.00
Value added	90.00	210.00	405.00	0.00	0.00	0.00	705.00
Output	300.00	500.00	700.00	495.00	185.00	125.00	
Input-output table of imports							
Agriculture	3.71	7.69	2.61	0.86	0.86	1.61	17.34
Industry	13.74	16.69	6.16	2.54	2.54	1.83	43.50
Services	12.55	15.62	6.23	1.60	1.60	1.56	39.17
Total	30.00	40.00	15.00	5.00	5.00	5.00	100.00
Input-output table of supply and use							
Agriculture	30.49	51.39	114.20	74.30	20.11	26.85	317.34
Industry	91.91	107.16	78.49	123.97	87.82	54.15	543.50
Services	87.60	131.45	102.31	296.73	77.07	44.00	739.17
Value added	90.00	210.00	405.00	0.00	0.00	0.00	705.00
Output	300.00	500.00	700.00	495.00	185.00	125.00	2305.00
Imports of similar products	17.34	43.50	39.17	0.00	0.00	0.00	100.00
Supply	317.34	543.50	739.17	495.00	185.00	125.00	

11.8.5 Empirical application of the transformation models

Very few countries in the European Union compile product-by-product input-output tables and industry-by-industry input-output tables at the same time. Countries which are in a position to compile product-by-product input-output tables and industry-by-industry input-output tables at the same time have established a modern flexible macroeconomic data base which is open for many applications. An empirical example is given in the following two tables.

If supply and use tables at basic prices are available the compilation of industry-by-industry input-output tables with Model D (Fixed product sales structure assumption) is a simple mechanical procedure. However, the transformation of supply and use tables to product-by-product input-output tables with Model A (Product technology assumption) is more demanding. In this case, the transformation requires more resources and expertise. Large negative entries are indications for a mismatch of sources and assumptions on the supply and demand side of the supply and use system. Often it is not easy to trace the reasons for the conflicting elements. Eventually, manual balancing procedures are employed to remove the large negatives in the supply and use system and then a mechanical balancing procedure is started to remove the smaller negative entries. A big problem of this complicated procedure is the proper documentation of the manual balancing procedures.

If most activities are reported on the diagonal of the supply table, the difference between product-by-product input-output tables and industry-by-industry input-output tables is small. In the extreme case without secondary activities (all activities of industries are reported on the diagonal of the supply table) the two prototypes of input-output tables converge and the use table becomes an input-output table.

Product-by-product input-output tables

Many countries in the European Union compile product-by-product input-output tables with the product technology assumption (Model A). Sometimes large negative entries are removed in a manual balancing procedure. Other countries apply the Almon procedure to compile product-by-product input-output tables.

In Table 11.35 product-by-product input-output tables are presented which were compiled with the Almon procedure. This approach basically reflects the product technology assumption. The table includes the input-output tables of supply and use, the input-output table for domestic output and the input-output table for imports in an aggregated form (P7). The first table reflects the total requirements for intermediate and final uses disregarding the domestic or foreign origin. In the second and third part of the table, the input requirements for domestic products and imported products are reported for intermediate and final use.

Industry-by-industry input-output tables

Some countries in the European Union compile industry-by-industry input-output tables. They apply Model D (Fixed product sales structure) for the transformation of supply and use tables to input-output tables. The empirical example in Table 11.36 has been aggregated to six industries (A6) from a much larger input-output table with 59 industries (A60). The tables demonstrate that in this case the difference between product-by-product input-output tables and industry-by-industry input-output tables is not very large although the reported level of secondary industries for this country is above the average for the European Union.

11.9 Outlook

Supply and use tables and input-output tables always allow deducting the gross domestic product (GDP) in a most elaborate way. All structural elements of GDP are visible in one large matrix. In this table the interdependence in production between industries, branches and products becomes visible. The supply and use system is the framework which allows tracing the value-added-chains of industries. In most countries exports and imports are growing more rapidly than domestic production. The same observation is made for the use of domestic intermediates. The production process becomes more complex and more international. Insofar, the compilation of a sophisticated input-output database is essential for a modern nation.

Table 11.35: Product-by-product input-output table of supply and use at basic prices

Billions of HUF

	BRANCHES / PRODUCTS (CPA)	OUTPUT OF HOMOGENEOUS BRANCHES							FINAL USES								
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Input-output table for supply and use at basic prices																
1	Products of agriculture	221	503	1	18	3	17	763	252		11	15		53	167	498	1 261
2	Products of industry	281	4 133	404	407	236	312	5 773	1 901		122	812		304	4 008	7 146	12 919
3	Construction work	1	45	6	44	17	31	144	4		24	908		3	34	974	1 118
4	Trade, hotel, transport services	129	551	151	498	186	215	1 730	1 312		252	272		3	342	2 181	3 912
5	Private services	31	440	55	658	692	182	2 058	762		80	245		2	137	1 227	3 284
6	Other services	23	114	12	138	90	171	547	373	126	1 688	20		1	15	2 224	2 771
7	Total at basic prices	686	5 786	629	1 762	1 224	927	11 015	4 605	126	2 178	2 272		366	4 704	14 250	25 265
8	Net taxes on products	40	101	26	94	57	68	386	946		9	132		4	- 17	1 073	1 459
9	Dir. purch. abroad res.								146							146	146
10	Dom. purch. by non-res.								- 513						513		

11	Total at purch. prices	726	5 887	655	1 856	1 282	995	11 401	5 184	126	2 187	2 403		369	5 200	15 469	26 870
12	Comp. of employees	175	1 249	219	1 021	592	1 249	4 504									
13	O. net taxes production	- 26		1	2	2	- 1	- 23									
14	Cons. of fixed capital																
15	Operating surplus, net	314	1 118	241	1 007	932	505	4 117									
16	Value added at basic prices	462	2 366	461	2 030	1 526	1 753	8 598									
17	Output at basic prices	1 189	8 254	1 115	3 886	2 808	2 748	19 999									
18	Imports CIF	72	4 665	3	26	477	23	5 266									
19	Supply at basic prices	1 261	12 919	1 118	3 912	3 284	2 771	25 265									

Input-output table for domestic output at basic prices

1	Products of agriculture	208	463	1	18	3	17	710	236		11	13		51	167	479	1 189
2	Products of industry	200	1 321	258	283	155	221	2 438	1 342		68	208		189	4 008	5 815	8 254
3	Construction work	1	43	6	44	17	31	141	4		24	908		3	34	974	1 115
4	Trade, hotel, transport services	129	546	151	485	180	214	1 704	1 312		252	272		3	342	2 181	3 886
5	Private services	26	245	39	555	560	162	1 585	762		80	241		2	137	1 222	2 808
6	Other services	23	114	12	134	89	153	524	373	126	1 688	20		1	15	2 224	2 748
7	Total at basic prices	586	2 732	466	1 518	1 004	798	7 103	4 030	126	2 124	1 662		250	4 704	12 896	19 999
8	Imported products CIF	100	3 055	162	244	221	130	3 911	574		54	610		116		1 355	5 266
9	Net taxes on products	40	101	26	94	57	68	386	946		9	132		4	- 17	1 073	1 459
10	Dir. purch. abroad res.								146							146	146
11	Dom. purch. by non-res.								- 513						513		
12	Total at purch. prices	726	5 887	655	1 856	1 282	995	11 401	5 184	126	2 187	2 403		369	5 200	15 469	26 870
13	Comp. of employees	175	1 249	219	1 021	592	1 249	4 504									
14	O. net taxes production	- 26		1	2	2	- 1	- 23									
15	Cons. of fixed capital																
16	Operating surplus, net	314	1 118	241	1 007	932	505	4 117									
17	Value added at basic prices	462	2 366	461	2 030	1 526	1 753	8 598									
18	Output at basic prices	1 189	8 254	1 115	3 886	2 808	2 748	19 999									

Input-output table for imports at basic prices

1	Products of agriculture	13	40					53	16			2		1		19	72
2	Products of industry	81	2 813	146	123	81	91	3 334	558		54	604		114		1 331	4 665
3	Construction work		2					3									3
4	Trade, hotel, transport services		5		13	7	1	26									26
5	Private services	6	195	16	103	132	20	472				4				4	477
6	Other services				4	1	18	23									23
7	Total at basic prices	100	3 055	162	244	221	130	3 911	574		54	610		116		1 355	5 266

Production approach		Income approach		Expenditure approach	
Total output at basic prices	19 999	Compensations of employees	4 504	Household final consumption expenditure	5 184
- Intermediate consumption	- 11 401	+ Other net taxes on production	- 23	+ NPISH final consumption expenditure	126
		+ Gross operating surlus	4 117	+ Government consumption expenditure	2 187
= Value added at basic prices	8 598	= Value added at basic prices	8 598	+ Gross fixed capital formation	2 403
+ Taxes less subsidies on products	1 459	+ Taxes less subsidies on products	1 459	+ Changes in inventories	0
				+ Acquisitions less disposals of valuables	369
				+ Exports of goods and services	5 200
				- Imports of goods and services	- 5 266
				- Direct purchases abroad by residents	- 146
= Gross domestic product	10 057	= Gross domestic product	10 057	= Gross domestic product	10 057

Hungary 1998

Table 11.36: Industry-by-industry input-output table at basic prices

Billion HUF

No	INDUSTRIES / INDUSTRIES	OUTPUT OF INDUSTRIES							FINAL USES								
		Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports fOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Input-output table for supply and use at basic prices																
1	Products of agriculture	225	461	4	55	6	18	769	267		11	22		52	180	532	1 301
2	Products of industry	288	4 123	385	514	243	322	5 876	1 917		123	878		299	3 925	7 142	13 018
3	Construction work	2	53	10	48	18	32	163	14		23	805		3	42	887	1 050
4	Trade, hotel, transport services	133	578	138	488	185	216	1 736	1 323		252	299		8	403	2 285	4 021
5	Private services	38	452	47	607	650	166	1 961	732		81	243		3	135	1 194	3 156
6	Other services	24	111	12	126	84	153	509	352	126	1 689	25		1	18	2 211	2 720
7	Total at basic prices	710	5 777	597	1 838	1 186	907	11 015	4 605	126	2 178	2 272		366	4 704	14 250	25 265
8	Net taxes on products	41	104	25	94	55	67	386	946		9	132		4	- 17	1 073	1 459
9	Dir. purch. abroad res.								146							146	146
10	Dom. purch. by non-res.								- 513						513		
11	Total at purch. prices	751	5 881	622	1 932	1 240	975	11 401	5 184	126	2 187	2 403		369	5 200	15 469	26 870
12	Comp. of employees	184	1 289	200	1 050	552	1 228	4 504									
13	O. net taxes production	- 26	1		1	2	- 1	- 23									
14	Cons. of fixed capital																
15	Operating surplus, net	319	1 182	225	1 011	885	495	4 117									
16	Value added at basic prices	477	2 472	425	2 063	1 439	1 722	8 598									
17	Output at basic prices	1 228	8 353	1 047	3 995	2 679	2 696	19 999									
18	Imports CIF	72	4 665	3	26	477	23	5 266									
19	Supply at basic prices	1 301	13 018	1 050	4 021	3 156	2 720	25 265									
	Input-output table for domestic output at basic prices																
1	Products of agriculture	211	422	4	55	6	18	716	251		11	20		50	180	512	1 228
2	Products of industry	207	1 346	248	343	164	234	2 542	1 359		68	274		185	3 925	5 811	8 353
3	Construction work	2	50	10	48	18	32	160	14		23	805		3	42	887	1 047
4	Trade, hotel, transport services	132	573	138	474	178	215	1 710	1 323		252	299		8	403	2 285	3 995
5	Private services	31	256	33	497	526	147	1 489	732		81	239		3	135	1 190	2 679
6	Other services	24	111	12	122	83	135	486	352	126	1 689	25		1	18	2 211	2 696
7	Total at basic prices	608	2 757	445	1 539	974	780	7 103	4 030	126	2 124	1 662		250	4 704	12 896	19 999
8	Imported products CIF	102	3 020	152	299	211	127	3 911	574		54	610		116		1 355	5 266
9	Net taxes on products	41	104	25	94	55	67	386	946		9	132		4	- 17	1 073	1 459
10	Dir. purch. abroad res.								146							146	146
11	Dom. purch. by non-res.								- 513						513		
12	Total at purch. prices	751	5 881	622	1 932	1 240	975	11 401	5 184	126	2 187	2 403		369	5 200	15 469	26 870
13	Comp. of employees	184	1 289	200	1 050	552	1 228	4 504									
14	O. net taxes production	- 26	1		1	2	- 1	- 23									
15	Cons. of fixed capital																

16 Operating surplus, net	319	1 182	225	1 011	885	495	4 117									
17 Value added at basic prices	477	2 472	425	2 063	1 439	1 722	8 598									
18 Output at basic prices	1 228	8 353	1 047	3 995	2 679	2 696	19 999									
Input-output table for imports at basic prices																
1 Products of agriculture	13	39					53	16			2		1		19	72
2 Products of industry	82	2 776	137	171	79	89	3 334	558		54	604		114		1 331	4 665
3 Construction work		2					3									3
4 Trade, hotel, transport services		5		13	7	1	26									26
5 Private services	7	197	15	111	124	20	472				4				4	477
6 Other services				4	1	18	23									23
7 Total at basic prices	102	3 020	152	299	211	127	3 911	574		54	610		116		1 355	5 266

Production approach		Income approach		Expenditure approach	
Total output at basic prices	19 999	Compensations of employees	4 504	Household final consumption expenditure	5 184
- Intermediate consumption	- 11 401	+ Other net taxes on production	- 23	+ NPISH final consumption expenditure	126
		+ Gross operating surlus	4 117	+ Government consumption expenditure	2 187
= Value added at basic prices	8 598	= Value added at basic prices	8 598	+ Gross fixed capital formation	2 403
+ Taxes less subsidies on products	1 459	+ Taxes less subsidies on products	1 459	+ Changes in inventories	0
				+ Acquisitions less disposals of valuables	369
				+ Exports of goods and services	5 200
				- Imports of goods and services	- 5 266
				- Direct purchases abroad by residents	- 146
= Gross domestic product	10 057	= Gross domestic product	10 057	= Gross domestic product	10 057

Hungary 1998

Each Member State of the European Union submits annual supply and use tables and symmetric input-output tables at least in five-yearly intervals for the transmission programme of ESA 1995. The compilation of the supply table at basic prices with a transformation to purchasers' prices and of the use tables at purchasers' prices requires the calculation of valuation matrices for trade and transport margins and taxes and subsidies on products. In principle, the database of supply and use tables and valuation matrices also allow to compile supply and use tables at basic prices without much further effort.

Supply and use tables at basic prices are the appropriate database for the deflation of GDP and the transformation of supply and use tables to input-output tables. In addition to supply tables at basic prices also use tables at basic prices are part of the standard supply and use system. Supply and use tables at basic prices are required for the constant prices calculations of GDP and for the current exploitation of supply and use tables for analytical purposes.

Preferable are use tables also in basic prices, so that symmetric input-output tables could be constructed at annual intervals. These annual use tables should be broken down into import and domestic components. The symmetric input-output table at basic prices and the symmetric input-output tables for domestic output and imports at basic prices at five-yearly intervals are less relevant due to the time lag and low frequency of their data. Annual supply and use tables for domestic output and imports at basic prices offer the opportunity for the user of compiling input-output tables according to the specific needs of the analysis.

Input-output data are often used as the data base of macroeconomic models. Symmetric input-output tables have the benefit that they are easy to handle. However, with the microeconomic foundation of macroeconomic analysis rectangular supply and use systems gain importance. Insofar, the national statistical offices are encouraged to provide access to rectangular input-output data. At best the statistical offices should also compile input-output tables annually.

The use table at basic prices should be made part of the standard supply and use system, as it is needed for the constant price calculation and for the direct use of the supply and use tables for analytical purposes. The choice and definition of economic activities in a consistent system of national accounts tables (annual, quarterly, supply and use tables, symmetric input-output tables) have a direct impact on the quality and the resource requirement of the national accounts, including the ability of the statisticians to maintain a system of consistent time series over several rounds of major revisions, changes in basic classifications, and changes of base year for constant price calculations.

The situation of a "stand-alone" input-output table for every five years should be evaluated against the case of time series of input-output tables, comparability to other types of data, the ease with which it can be revised, the transparency of compilation methods and the resources needed for the compilation.

When input-output statistics are compiled in practice it is essential to take into account the desired properties and compilation methods of the symmetric input-output tables already while working on supply and use tables. By making appropriate choices of the groupings and structure of the supply and use tables it is possible to construct a data base which is relevant and useful in the current national accounts and at the same time can be transformed into a symmetric input-output table with a minimum of data manipulation.

It is recommended to implement a three step approach (Thage and ten Raa 2006):

1. Compilation of supply and use tables
2. Preparation of input-output data for analytical uses
3. Calculation of standard analytical results

The first step consists basically of defining the industries in the supply and use tables and in the activity tables of the national accounts in general in such a way that industries have no secondary production in other *tabulation categories* (i.e. broad industry groups such as agriculture, fishing, mining, manufacturing, construction etc). If the KAUs for which statistics are available do not automatically fulfil this condition, it is the task of the national accountants to make further breakdowns ("create new KAUs") until this condition is fulfilled, both for horizontally and vertically integrated units. Such additional breakdowns are typically made manually based on the best available information and judgement of the national accountants. As there is most often no specified intermediate consumption available for these types of "created KAUs" the redefinition can be implemented just by moving some parts of the totals for intermediate consumption between industries, thus also greatly facilitating the subsequent compilation of the detailed input structures in the supply table.

The second step of preparing input-output data for analytical uses provides three main options:

- Direct application of rectangular supply and use tables with supply and use tables at basic prices
- Compilation of symmetric product-by-product input-output tables based on product technology assumption (Model A).
- Compilation of symmetric industry-by-industry input-output tables based on the fixed product sales structure assumption (Model D)

The increased focus on supply and use tables has been an important trend during the decade. More countries produce such tables as an integrated part of their national accounts work, following the recommendation given in the 1993 SNA to apply the commodity flow method as the basic compilation techniques for the production part of the national accounts in both current and constant prices. Additionally, the direct application of supply and use tables in economic analysis has become more wide-spread. This development is based on both computational and analytical progress, down to econometric analysis of micro data directly in connection with the analysis. Insofar, a flexible approach is the best option. What matters is that the user is in a position to find his/her own aggregation of input-output data according to his/her specific needs.

A comprehensive supply and use system incorporates the following tables:

- Supply table a basic prices
- Use table of domestic output at basic prices
- Use table of imports at basic prices
- Valuation matrices
- Supply table at basic prices, including a transformation into purchasers' prices
- Use table at purchasers' prices

- Symmetric input-output table for supply and use at basic prices
- Symmetric input-output table for domestic output at basic prices
- Symmetric input-output table for imports

On the basis of the supply and use tables at basic prices, the industry-by-industry input-output tables and product-by-product input-output tables are derived. In the transmission programme for ESA 1995 the submission of product-by-product input-output tables is requested. The transmission of industry-by-industry input-output tables is accepted provided that the industry-by-industry approach is a good approximation of the product-by-product approach.

Supply and use tables are comprised of the main macroeconomic data. They are also used as the basis for the derivation of input-output tables. Both industry-by-industry and product-by-product tables find their origin in the supply and use system. In order to derive input-output tables from supply and use tables it is necessary to make assumptions. This implies that input-output tables have a more artificial character than supply and use tables and are at a greater distance from observed data.

Supplementary information and disaggregation of expenditure

chapter 12

eurostat

12.1 Introduction

In this Chapter 12 and the following Chapter 13 (Extended input-output tables as part of satellite systems), the main potentials of extending input-output tables are discussed. Chapter 12 deals with extensions which do not change the concepts of the input-output tables according to the European System of National Accounts (ESA 1995). These extensions only supplement the basic input-output tables.

In Section 12.2, additional information on production factors (labour inputs, fixed assets) and physical flows (e.g. raw materials, energy, water, waste, pollutants) is covered while in Section 12.3 further disaggregations of production activities and final demand categories by purpose are presented.

In the following Chapter 13 (Extended input-output tables as part of satellite systems) conceptual changes towards satellite systems are discussed. Furthermore, Chapter 13 presents extensions of production boundaries as well as the use of non-monetary units describing economic activities.

The explanations of supplementary data and disaggregation of expenditures in this chapter cannot replace detailed information on the concepts and compilation methods of the different topics which is given in other handbooks:

- With regard to *labour inputs*, the Eurostat Handbook on Social Accounting Matrices and Labour Accounts (Eurostat 2002a) gives an excellent overview, in particular in Chapter 4 (Labour Accounting System).
- A detailed discussion of *fixed assets* is presented in the OECD Manual on Measuring Capital (OECD 2001).
- An extensive description of linking *physical flows* with national accounts is given in the United Nations Handbook on Integrated Environmental and Economic Accounting (United Nations 2003).
- Further information on disaggregating final expenditure according to purpose can be found in a special publication of the United Nations on this subject (United Nations 2000a).

The following presentation is restricted to some introductory information on the concepts of the supplementary data and their possible linkages with input-output tables. Furthermore, some remarks are made on their use in the context of satellite systems which are illustrated by some numerical examples.

12.2 Supplementary information

According to the obligatory *transmission programme* of national accounts data to Eurostat, the following supplementary data has to be submitted as additional rows in the annual use tables:

- fixed capital formation at current prices,
- fixed capital stock at current prices, and
- labour inputs (1.000 persons).

Table 12.1 presents an empirical example of supply and use tables with supplementary tables. The supplementary information on gross fixed capital formation, capital stock and labour inputs allows evaluating the labour and capital intensities of industries. The information on gross fixed capital formation is normally derived from an investment matrix identifying the capital goods and investing industries. A time series of corresponding investment matrices is the database for the calculation of capital stock data with the Perpetual Inventory Method (PIM).

In macroeconomic models the supply and use tables with the supplementary information on gross fixed capital formation, capital stock and labour inputs can be used for various purposes. The applications include amongst others

- impact analysis of European regional policy,
- evaluation of labour policies,
- capital and economic growth
- productivity analysis,

- diversification and integration of economic activities, and
- impact analysis of economic policies on growth, price stability, employment and foreign trade.

In the future, time series of annual supply and use tables with supplementary data will open new opportunities for economic analysis.

12.2.1 Labour inputs

Labour inputs can be measured by employment, jobs, total hours worked or full-time equivalents (see ESA 1995, Chapter 11: Population and Labour Input):

- *Employment* covers all persons - both employees and self-employed - engaged in some productive activity that falls within the production boundary of the system (ESA 1995, par. 11.11),
- The concept of *jobs* differs from the concept of employment by including second, third etc. jobs of the same person and by excluding persons temporarily not at work but who have a 'formal attachment to their job' (ESA 1995, par. 11.23),
- *Total hours worked* represent the aggregate number of hours actually worked as an employee or self-employed during the accounting period, when their output is within the production boundary (ESA 1995, par. 11.26),
- *Full-time equivalent employment* equals the number of full-time equivalent jobs, defined as total hours worked divided by the average annual number of hours worked in full-time jobs within the economic territory (ESA 1995, par. 11.32).

According to the obligatory *transmission programme* for ESA 1995, data on employees, self-employed persons and hours worked are delivered in a classification by 60 industries (A60) and by 31 industries (A31) for employment data before 1990 on an annual basis.

Apart from the differences with regard to the activity classification (industries versus branches), the two data sets might also differ with regard to the persons working via temporary employment agencies. In the symmetric input-output tables, it is recommended that these persons are reclassified according to the branch where they are actually working. This *user principle* facilitates labour productivity analysis (see ESA 1995, par. 9.29e, 9.51h and 11.13i). These conceptual changes also imply corresponding changes of the concepts of the compensation of employees. The gross output of employment agencies will be reduced to a service charge.

It is recommended that data on labour inputs should be recorded in a classification by 60 industries as well as by 60 branches at least on a five-yearly basis. The linkages between these data sets could be shown in a matrix which not only transforms labour inputs from institutionally defined industries to product defined branches but also reveals the reclassification of persons working via temporary employment agencies.

The figures on employees and self-employed persons in a breakdown by industry and branch respectively link demographic and social statistics with economic analysis. For this purpose, they are perfectly suitable. Nevertheless, information on hours worked is the preferable labour input variable for productivity analysis (see ESA 1995, par. 9.28). Such figures can take into account second or third jobs as well as part-time occupation of the economically active population (Kazemer, Brugt and Exel 1992).

If possible, additional information on the levels of general and vocational education of employees and self-employed persons should be collected to facilitate a qualitative analysis of the labour inputs of the industries and branches respectively. If information on the average labour hours of employees and self-employed persons differentiated by their education is used, it is also possible to estimate the hours worked by industry or branch by education levels (Bos 1996).

Table 12.2 gives an example for Germany. It should be mentioned that both employed persons and hours worked are recorded twice, according to their highest degree of general education as well as according to their highest degree of vocational education.

Table 12.1: Supply and use tables with supplementary data

Supply table at basic prices — Billions of DKK

No	INDUSTRIES (NACE) / PRODUCTS (CPA)	OUTPUT OF INDUSTRIES (NACE): Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	IMPORTS: Intra EU imports CIF	Extra EU imports CIF	Imports cif	Total supply at basic prices	VALUATION: Trade and transport margins	Taxes less subsdies on products	Total supply at basic prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Products of agriculture	69	3					72	7	5	12	84	13	- 1	96
2	Products of industry		583					583	244	103	347	930	196	130	1 257
3	Construction work			153				153				153		20	173
4	Trade, hotel, transport services				527		2	529	38	57	95	623	- 211	10	422
5	Private services		7		4	400	1	414	19	10	29	442	2	16	460
6	Other services					1	419	420	2	1	2	422		8	430
7	Total	69	593	153	531	401	421	2 170	309	176	485	2 655		183	2 838
8	CIF/FOB adjustments on imports														
9	Direct purchases abroad by residents								26	12	39	39			39
10	Output at basic prices	69	593	153	531	401	421	2 170	335	189	524	2 694		183	2 877

Use table at basic prices

No	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES (NACE): Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total	FINAL USES: Final consumption expenditure by households	Final consumption expenditure by non-profit organisations	Final consumption expenditure by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exportsextra EU FOB	Total	Total use at purchasers' prices
No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Products of agriculture	12	44	1	2		2	61	17		1			1	11	5	35	96
2	Products of industry	18	245	63	63	23	38	450	289		7	107	1	10	258	133	807	1 257
3	Construction work	1	4	1	7	24	7	44	3		6	120					129	173
4	Trade, hotel, transport services	2	24	5	146	21	20	218	75						57	72	204	422
5	Private services	7	32	22	56	75	36	229	162		4	32			21	12	231	460
6	Other services	1	6	1	7	9	24	48	62	10	306	2	1		2	1	382	430
7	Total at basic prices	40	355	92	282	152	127	1 049	608	10	325	261	2	11	349	223	1 789	2 838
8	CIF/FOB adjustments on exports																	
9	Direct purch. abroad by residents		1		7	1	1	10	29								29	39
10	Dom. purch. by non-residents								- 30						25	5		
11	Total at purchasers' prices	40	357	92	289	153	128	1 059	607	10	325	261	2	11	375	228	1 818	2 877
12	Compensation of employees	8	128	45	156	98	246	682										
13	Other net taxes on production	- 1	- 1		- 1	5	- 3	- 1										
14	Consumption of fixed capital	11	38	5	46	68	35	204										
15	Operating surplus, net	10	72	11	41	76	15	225										
16	Value added at basic prices	29	237	61	242	248	294	1 111										
17	Output at basic prices	69	593	153	531	401	421	2 170	607									

Supplementary data

No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
18	Fixed capital formation	11	45	6	68	98	33	261										261
19	Fixed capital stock	189	510	41	508	1 929	604	3 781										3 781
20	Labour inputs (1.000 persons)	95	468	167	703	358	973	2 764										2 764

Denmark 2000

The data base in Germany did not allow a combined classification by general and vocational education levels which would reflect the individual "biography" of formal education (Stahmer, Ewerhart and Herrchen 2000; Ewerhart 2001).

Table 12.2: Employment and total hours worked by level of education and branch

No.	Levels of education	Branches								
		Agriculture, forestry, fishing	Mining, water and energy supply	Manufacturing	Construction	Market services	Non-market services	Education services (general)	Education services (vocational)	Totals
		1	2	3	4	5	6	7	8	9
	Employment (1000 persons)									
1	**Highest completed level of general education**	**987**	**450**	**8 659**	**1 937**	**10 721**	**4 390**	**962**	**380**	**28 486**
2	with and without secondary modern school leaving certificte	803	312	5 937	1 514	5 536	1 873	140	67	16 182
3	intermediate school leaving certificate	131	93	1 702	292	3 166	1 448	150	61	7 043
4	qualification for polytechnic admission	15	19	325	48	417	261	56	17	1 158
5	general qualification for university admission	38	27	695	83	1 602	809	615	235	4 103
6	**Highest completed level of vocational education**	**987**	**450**	**8 658**	**1 937**	**10 722**	**4 390**	**962**	**380**	28 486
7	**Students**	**114**	**28**	**699**	**140**	**814**	**336**	**45**	**20**	**2 197**
8	in vocational schools	101	20	560	108	626	263	23	12	1 713
9	in polytechnics	4	2	38	9	49	19	1	1	124
10	in universities	9	6	101	23	138	54	21	8	360
11	**Excluding students**	**873**	**422**	**7 959**	**1 797**	**9 908**	**4 054**	**917**	**359**	**26 289**
12	without (vocational) degree	302	60	1 654	316	1 844	777	68	35	5 055
13	with completed apprenticeship	455	284	4 910	1 198	6 426	2 447	174	83	15 976
14	with technical school leaving certificate	93	50	837	209	677	305	58	25	2 254
15	with polytechnic degree	12	19	302	46	320	298	39	16	1 052
16	with university degree	12	10	256	28	642	227	578	200	1 952
	Total hours worked (millions of hours)									
17	**Highest completed level of general education**	**2 035**	**743**	**13 822**	**3 333**	**17 404**	**7 103**	**1 309**	**518**	**46 268**
18	with and without secondary modern school leaving certificte	1 648	501	9 438	2 591	8 878	2 971	173	89	26 289
19	intermediate school leaving certificate	272	162	2 721	507	5 125	2 336	201	81	11 406
20	qualification for polytechnic admission	32	33	521	84	691	430	77	23	1 892
21	general qualification for university admission	82	47	1 142	151	2 710	1 365	858	326	6 681
22	**Highest completed level of vocational education**	**2 035**	**743**	**13 822**	**3 333**	**17 404**	**7 103**	**1 309**	**518**	**46 268**
23	**Students**	**226**	**39**	**1 018**	**216**	**1 184**	**485**	**39**	**20**	**3 229**
24	in vocational schools	209	31	883	182	1 002	415	26	15	2 763
25	in polytechnics	8	4	63	16	81	31	2	1	206
26	in universities	8	4	73	18	101	39	12	4	259
27	**Excluding students**	**1 809**	**704**	**12 804**	**3 117**	**16 220**	**6 618**	**1 270**	**499**	**43 039**
28	without (vocational) degree	554	80	2 311	473	2 613	1 085	68	38	7 222
29	with completed apprenticeship	975	470	7 990	2 091	10 550	3 990	204	106	26 375
30	with technical school leaving certificate	220	96	1 492	404	1 226	550	79	35	4 102
31	with polytechnic degree	30	36	531	90	589	549	55	23	1 902
32	with university degree	30	21	480	59	1 243	444	864	297	3 438

Germany 1990

12.2.2 Capital formation and capital stock

Fixed assets are another important production factor in economic activities which should be recorded in a breakdown by industries (and branches) as supplementary information in the input-output framework. According to the ESA 1995 definition, fixed assets comprise produced assets which are used repeatedly or continuously in production for more than one year (ESA 1995, par. 7.15). These fixed assets could be *tangible* like buildings, machinery and equipment or cultivated natural assets used for breeding, dairy, draught or yielding repeat products (ESA 1995, par. 7.33). They also could be *intangible* like the value of mineral exploration, computer software, literary or artistic originals, etc. (ESA 1995, par. 7.34 - 7.36). The ESA 1995 definition of fixed assets excludes consumer durables used for consumption purposes as well as non-produced assets like land which is also continuously used in production for more than one year.

Gross *fixed capital formation* by industry (and branch) also provides important supplementary information for input-output analysis. These data are needed for estimating investment functions, often connected with figures on the corresponding assets. According to the ESA 1995 definitions, gross fixed capital formation not only consists of acquisitions less disposals of (tangible and intangible) fixed assets but also major improvements to tangible non-produced assets, in particular those pertaining to land and costs associated with the transfers of ownership of non-produced assets (ESA 1995, par. 3.102 - 3.111). Thus, the concepts of fixed assets and gross fixed capital formation do not completely correspond with each other which complicates a combined use in input-output analysis. It might be preferable in this case to exclude transactions linked with non-produced assets.

According to the *transmission programme* of Eurostat, data on gross fixed capital formation is compulsory for 6 industries and voluntary for 31 industries (A31) and 60 industries (A60). Gross and net figures of fixed assets have to be delivered every year in a cross-classification by 17 industries (A17) and by 6 groups of non-financial assets (AN_F6) Both data sets, fixed capital formation as well as fixed assets, have to be recorded at current prices. If possible, these data should be disaggregated by 60 industries and shown as supplementary information of the use tables in the input-output framework.

Gross fixed capital formation and fixed assets should also be transformed for the five-yearly symmetric input-output tables with 60 product-defined branches (P60). In this case, a reclassification of both fixed capital formation and fixed capital stock for fixed assets that are rented out by the owner, e.g. in the case of operating leasing, is recommended. These fixed assets could be recorded as if they were owned by the user (see ESA 1995, par. 9.29d and 9.51g). Necessary adoptions of the other parts of the related flows should also be taken into account. Such necessary modification corresponds with the user concept in the case of labour inputs for facilitating productivity analysis.

For productivity analysis, the gross concept of fixed assets is preferable (ESA 1995, par. 9.27). According to this gross concept, all fixed assets should be valued at current market prices of new assets of the same type and quality; no deduction should be made for consumption of fixed capital in the last and earlier years. Furthermore, productivity analysis requires not just stock data at the beginning or the end of the respective reporting period but average figures which might be calculated at constant prices first and, in a second step, valued with the average investment good prices of the respective period.

If possible, it is recommended to publish special transformation matrices for fixed capital formation and fixed assets which show the transition from the institutionally defined industry data (owner concept) to the product-defined branch data (user concept).

Consumer durables are durable goods used by households repeatedly over periods of time of more than one year for final consumption (ESA 1995, par. 7.63). They are included in the balance sheets only as memorandum items because they are not gradually used up in production processes but in consumption activities. If data were available, the acquisitions less disposals of consumer durables as well as the value of their stocks could be shown as supplementary information of final consumption expenditures in the use table and in the symmetric input-output table.

In satellite analysis, the production boundary might be extended and consumer durables will become part of fixed capital formation and fixed assets (see SNA 1993, par. 21.31).

Some *non-produced assets* are also repeatedly or continuously used in production for more than one year. In this case, they are used in the same way as the described produced fixed assets and could be recorded as supplementary information associated to the using industries (branches). The most prominent case is land but also some non-cultivated biological resources (e.g. meadows) and water resources might belong to fixed assets in a broader definition.

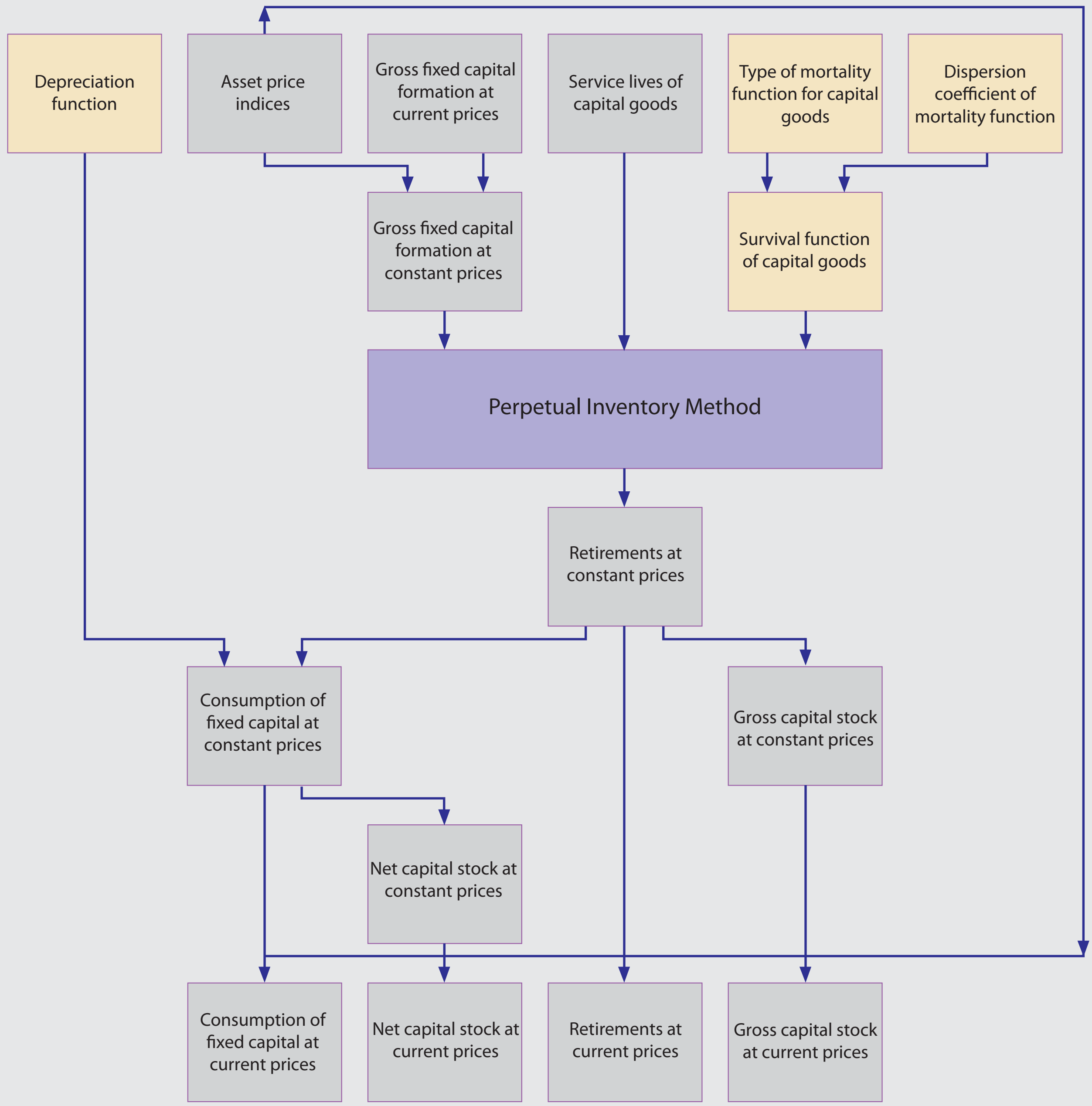
Non-produced assets only belong to the economic assets having a monetary value if ownership rights are enforced by institutional units, individually or collectively, and if economic benefits are derived by their owners by holding them or using them over a period of time (ESA 1995, par. 7.10). In these cases, they are valued as if they are acquired on the date to which they relate (ESA 1995 par. 7.25).

It is preferable to show the non-produced assets in monetary terms as supplementary information of the input-output framework for facilitating comparisons with the other types of fixed assets. In the case of land, additional physical information on the areas used by the different industries (branches) and by consumption purposes is useful.

Box 12.1: Measuring capital

Most countries compile capital stock data from cumulative investment in the past with the Perpetual Inventory Method. For the calculation of long time series for gross fixed capital formation by type of capital good, for asset price indices and for the service lives of capital goods the following data are required.

Practical application of the Perpetual Innventory Method (PIM)



Gross fixed capital formation is measured by the total value of a producer's acquisitions, less disposals, of fixed assets during the accounting period plus certain additions to the value of non-produced assets realised by productive activity of institutional units.

The *gross capital stock* is the gross value of capital used in production at a given point in time. It represents the cumulative value of past investment less accumulated retirements of capital goods. Thus it is equivalent with the cumulative value of past investment still in use. It is the value of the capital goods still in use at prices as if they were new. No depreciation or loss in value is deducted.

Retirements of capital goods represent the gross value of capital goods which are physically withdrawn from the capital stock at the end of their services lives.

The *net capital stock* represents the cumulative value of past investment less accumulated consumption of fixed capital. It is equivalent with the financial value of the gross capital actually in use.

Consumption of fixed capital is the amount of fixed capital used up in current production. It represents the reduction in the value of the fixed assets used in production during an accounting period resulting from physical deterioration, normal obsolescence and normal accidental damage.

Table 12.3: Gross stock of fixed assets by branch and by household consumption activity at replacement costs

Billions of Deutsche Marks

Ser. No.	Branches	Value added	Tangible fixed assets and consumer durables	Fixed assets coefficient (3) = (2)/(1)	Education capital	Education capital coefficient (5) = (4)/(1)	Fixed assets intensity of education capital (6) = (2)/(4)
		1	2	3	4	5	6
	Production activties						
1	Agriculture	28	321	*11.6*	62	*2.2*	*5.2*
2	Forestry and fishing etc.	8	26	*3.2*	11	*1.3*	*2.4*
3	Electricity, steam, hot water supply	42	387	*9.3*	18	*0.4*	*22.1*
4	Gas supply	8	48	*6.1*	2	*0.2*	*25.6*
5	Water supply	7	118	*17.9*	3	*0.4*	*44.2*
6	Coal mining	6	43	*6.9*	10	*1.5*	*4.6*
7	Other mining (excl. coal mining, crude petroleum, natural gas)	1	7	*9.5*	1	*1.9*	*5.0*
8	Extraction of crude petroleum, natural gas	2	9	*5.1*	-	-	-
9	Manufacturing of chemical products (incl. nuclear fuel)	62	176	*2.9*	42	*0.7*	*4.2*
10	Manufacturing of refined petroleum products	25	24	*0.9*	1	*0.0*	*19.6*
11	Manufacturing of plastic products	23	44	*1.9*	20	*0.9*	*2.2*
12	Manufacturing of rubber products	7	15	*2.0*	6	*0.8*	*2.5*
13	Quarrying of stones and clays, manufacturing of building material, etc.	19	57	*3.0*	14	*0.7*	*4.1*
14	Manufacturing of ceramic products .	3	6	*2.1*	3	*1.2*	*1.9*
15	Manufacturing of glass and glass products	6	17	*3.0*	5	*0.8*	*3.8*
16	Manufacturing of iron and steel ..	16	60	*3.8*	10	*0.6*	*6.3*
17	Manufacturing of non-ferrous metals, semifinished products thereof	6	22	*3.5*	4	*0.6*	*5.7*
18	Manufacturing of foundry products	10	23	*2.3*	9	*0.9*	*2.6*
19	Manufacturing of drawing plants products, cold rolling mills etc.	22	37	*1.7*	21	*0.9*	*1.8*
20	Manufacturing of structural metal products, rolling stock	14	18	*1.3*	13	*0.9*	*1.4*
21	Manufacturing of machinery and equipment (excl. electrical)	90	131	*1.5*	83	*0.9*	*1.6*
22	Manufacturing of office machinery, autom. data processing equipment	9	18	*2.0*	9	*0.9*	*2.2*
23	Manufacturing of road vehicles	81	196	*2.4*	63	*0.8*	*3.1*
24	Building of ships, boats and floating structures	2	7	*3.5*	3	*1.2*	*2.9*
25	Manufacturing of aircraft and spacecraft	7	10	*1.4*	5	*0.7*	*1.9*
26	Manufacturing of electrical machinery, equipment and appliances	88	132	*1.5*	77	*0.9*	*1.7*
27	Manufacturing of precision and optical instruments, clocks and watches	15	19	*1.3*	16	*1.1*	*1.2*
28	Manufacturing of tools and finished metal products	27	50	*1.8*	23	*0.9*	*2.1*
29	Manufacturing of musical instruments, games and toys, sports goods	5	9	*1.9*	5	*1.0*	*1.9*
30	Manufacturing of wood	3	13	*3.8*	4	*1.1*	*3.6*
31	Manufacturing of wood products	18	33	*1.8*	24	*1.3*	*1.4*
32	Manufacturing of pulp, paper and -board	6	23	*4.0*	3	*0.5*	*7.4*
33	Manufacturing of paper and -board products	9	22	*2.5*	8	*0.9*	*2.7*
34	Printing and duplicating	21	48	*2.3*	19	*0.9*	*2.5*
35	Manufacturing of leather and leather products, footwear	3	10	*3.3*	4	*1.3*	*2.6*

36	Manufacturing of textiles	14	49	*3.6*	13	*1.0*	*3.6*
37	Manufacturing of wearing apparel	9	15	*1.6*	13	*1.5*	*1.1*
38	Manufacturing of food products (excl. beverages)	42	106	*2.5*	50	*1.2*	*2.1*
39	Manufacturing of beverages	12	54	*4.4*	6	*0.5*	*8.4*
40	Manufacturing of tobacco products	18	7	*0.4*	1	*0.1*	*6.0*
41	Construction (excl. installation and building completion)	77	77	*1.0*	85	*1.1*	*0.9*
42	Installation and building completion	47	21	*0.5*	56	*1.2*	*0.4*
43	Wholesale trade, etc., recycling	133	288	*2.2*	111	*0.8*	*2.6*
44	Retail trade	99	321	*3.2*	156	*1.6*	*2.1*
45	Railway transport	9	227	*25.1*	15	*1.7*	*15.1*
46	Water transport, ports	6	42	*6.9*	4	*0.6*	*12.2*
47	Post and telecommunication	50	269	*5.4*	32	*0.6*	*8.4*
48	Transport activities n.e.c.	59	172	*2.9*	55	*0.9*	*3.1*
49	Banking	-9	142	*-16.6*	46	*-5.4*	*3.1*
50	Insurance (excl. social security funds)	23	66	*2.9*	15	*0.7*	*4.3*

Germany 1990

Table 12.3: Gross stock of fixed assets by branch and by household consumption activity at replacement costs (continued)

Billions of Deutsche Marks

Ser. No.	Branches	Value added	Tangible fixed assets and consumer durables	Fixed assets coefficient (3) = (2)/(1)	Education capital	Education capital coefficient (5) = (4)/(1)	Fixed assets intensity of education capital (6) = (2)/(4)
		1	2	3	4	5	6
	Production activties						
51	Renting of real estate	239	4 635	*19.4*	-	-	-
52	Hotels and restaurants. homes and hostels	32	106	*3.3*	58	*1.8*	*1.8*
53	Research. cultural services and publishing	25	126	*5.1*	21	*0.9*	*5.9*
54	Health and veterinary market service activities	51	199	*3.9*	60	*1.2*	*3.3*
55	Other market service activities. etc.	247	306	*1.2*	185	*0.7*	*1.7*
56.1	External environmental protection services (waste water management)	6	218	*34.7*	4	*0.6*	*60.9*
56.2	External environmental protection services (solid waste management)	6	28	*5.0*	9	*1.5*	*3.3*
57.01	Education services of nursery schools	8	33	*4.4*	21	*2.8*	*1.6*
57.02	Education services of primary schools	16	58	*3.6*	25	*1.5*	*2.4*
57.03	Education services of secondary modern schools	10	42	*4.4*	18	*1.9*	*2.3*
57.04	Education services of intermediate schools	7	28	*4.3*	10	*1.6*	*2.7*
57.05	Education services of grammar schools	14	45	*3.2*	18	*1.3*	*2.5*
57.06	Education services of vocational schools	10	63	*6.6*	12	*1.3*	*5.3*
57.07	Education services of technical schools		5	*12.7*	1	*3.4*	*3.8*
57.08	Education services of polytechnics	2	12	*6.1*	4	*2.2*	*2.8*
57.09	Education services of universities	13	93	*7.1*	21	*1.6*	*4.5*
57.1	Further education services	5	29	*6.0*	12	*2.5*	*2.4*
58	Central and local government (excl. education services)	154	398	*2.6*	211	*1.4*	*1.9*
59	Social security funds	15	41	*2.7*	19	*1.3*	*2.1*
60	Private non-profit institutions (excl.educ.serv.), domestic services	46	182	*4.0*	66	*1.4*	*2.8*
	Total production activities	**557**	**1 582**	***2.8***	**635**	***1.1***	**2.5**
	Household consumption activities						
61	Own household management		317		1 828		*0.2*
61.1	Do-it-yourself		50		181		*0.3*
61.2	Search for employment/ commuting		162		336		*0.5*
61.3	Voluntary and community work		13		102		*0.1*
61.4.01	Studying activities related to nursery schools		3		-		-
61.4.02	Studying activities related to primary schools		6		15		*0.4*
61.4.03	Studying activities related to secondary modern schools		4		20		*0.2*
61.4.04	Studying activities related to intermediate schools		3		17		*0.2*
61.4.05	Studying activities related to grammar schools		5		28		*0.2*
61.4.06	Studying activities related to vocational schools		6		34		*0.2*
61.4.07	Studying activities related to technical schools				7		*0.0*
61.4.08	Studying activities related to polytechnics		1		17		*0.1*
61.4.09	Studying activities related to universities		3		79		*0.0*
61.4.10	Studying activities related to further education		5		54		*0.1*

61.5	Sleeping/ relaxing/ body care/ eating		431		-		-
61.6	Contacts/ conversation/ social life		152		916		*0.2*
61.7	Media use/ leisure activities		469		2 205		*0.2*
61.8	Taking care of children. adults and the elderly		53		269		*0.2*
61.9	Non-allocable activities of private households		74		-		-
	Total household consumption activities		**1 754**		**6 106**		***0.3***
	Totals		**12 435**		**8 135**		***1.5***

= empty

Germany 1990

In satellite systems, the concept of production can be extended. This implies that the borderline between consumption and capital formation is modified. According to these changes, the figures of fixed capital formation and fixed assets will increase. One example is the mentioned case of consumer durables which become capital formation, if household services are treated as production units (see SNA 1993 par. 21.31). The introduction of the concept of *human capital* is another case. These intangible fixed assets can be compiled by capitalising actual expenditures on education and possibly part of expenditures on health (see SNA 1993 par. 21.30). Supplementary information on the use of human capital by industry (branch) is very helpful for a comprehensive productivity analysis.

In Germany, *education capital* by branch has been estimated as a part of human capital. Further information is given in Chapter 13 (Extended input-output tables as part of satellite systems). In Table 12.3 presents an example of supplementary information on fixed assets for the year 1990 (Germany before re-unification). The table shows gross figures of tangible fixed assets according to the ESA 1995 definition (only produced assets), of consumer durables and of education capital at replacement costs by branch and by household consumption activity respectively. The educational capital of persons engaged in different activities is subdivided according to the time spent in these activities. The branch classification based on the 1990 national classification has been extended by different types of education services. Household consumption activities are classified by types of time use with special reference to studying activities. Table 12.3 also shows value added by branch and relationships between value added (output) and the different types of capital (production factors).

12.2.3 Physical flows

Input-output analysis has a long tradition in linking input-output tables in monetary units with supplementary information in physical units (Leontief 1973). Such linkages have especially been established in the case of energy inputs and pollution outputs. During the last years, material balances by branches in physical terms and physical input-output tables have been estimated which allow the calculation of linked monetary and physical data in a more systematic and comprehensive way (de Boer, Dalen and Konijn 1996; Gravgard Pedersen 1998; Stahmer 1998); Nebbia 1999). Such linkages are also recommended in the case of satellite analysis (SNA 1993 par. 21.110 to 21.113).

Five types of physical flows which also represent building blocks of material and energy balances can be used for linkages with monetary input-output tables:

- *Raw material inputs* withdrawn from nature. Such raw materials can be taken from all types of tangible non-produced assets (AN. 21) except of land (AN. 211) which belongs - as already mentioned - to the fixed assets. Raw materials comprise subsoil assets (AN. 212, like coal, oil and natural gases, metallic and non-metallic minerals), non-cultivated biological resources (AN. 213, like forests, plants, wild animals), and water resources (AN. 214). In the context of describing biological metabolism, air components like oxygen (animals) and carbon dioxide (plants) are also raw material inputs.
- *Product inputs* which are used as intermediate inputs for producing other products (e.g. in the context of energy transformation),
- *Residual inputs* which are normally unwanted by-products of production activities and which are re-used or treated in environmental protection facilities.
- *Product outputs* which are the wanted results of the production processes (“Goods”),

- *Residual outputs* which are mainly unwanted by-products and which are disposed back into nature (e.g. air pollution and untreated waste water) or which flow back into the economic circuit for re-use or treatment ("Bads").

In the context of German physical input-output tables 1990, complete material balances by 58 branches were estimated for energy transformation and combustion, for water use and for other materials. Special attention was given to establish complete balances of metabolism for all living beings (human beings, animals, plants) in Germany. These material balances were calculated in weight units (tons) (Stahmer 1998).

In the case of *energy balances*, additional information can also be given on the energy contents (in calorific values) of energy flows. This data base allows the compilation of the direct and indirect energy content of products (Beutel and Stahmer 1982). Such energy balances are especially necessary in the case of electric power production (e.g. by nuclear power plants or by hydropower).

Table 12.4 shows an example of complete material balances for energy transformation and energy combustion in tons for Germany in 1990. Such complete energy balances comprise raw material inputs (e.g. coal and crude oil extracted), intermediate energy inputs which are transformed into secondary energy sources or consumed (combusted), product outputs like primary and secondary energy sources which are marketed and residual outputs like mining overburden and air emissions connected with the transformation or combustion of energy. The column classification of branches lays special emphasis on energy producers. Furthermore, an energy balance is also shown for household consumption activities.

Table 12.4: Physical input and output table for energy

Millions of tons

Product type number	Materials	Aggregated branches of production							Consumption activities of households
		Electricity generation and distribution, steam, hot water	Gas production and distribution	Extraction of coal, manufacture of coal mining products	Extraction of crude oil and natural gas	Manufacturing of chemical products, fissile and fertile material	Manufacturing of refined petroleum products	Other branches of production	
		3	4	6	8	9	10	1, 2, 5, 7, 11-59	
Transformation (except combustion)									
Input (uses)									
	Raw material inputs								
	Mining overburden	-	-	958.0	0.1	-	-	-	-
	Energy carriers	-	-	177.8	15.6	-	-	-	-
	Other gases	-	-	1.1	0.1	-	-	-	-
	Total raw material inputs	-	-	1 136.9	15.8	-	-	-	-
	Product inputs								
4	Gases	-	0.5	-	-	1.3	-	0.1	-
6	Coale, coke and mine gas	-	0.7	36.6	-	2.4	-	6.2	-
8	Crude oil, natural gas	-	48.4	-	-	-	75.5	-	-
9	Chemical prod. (incl. nuclear fuel)	-	-	0.1	-	-	1.1	-	-
10	Refined petroleum products	-	-	1.0	-	13.0	16.3	3.9	0.2
56	Environmental protection services	-	0.4	-	-	-	-	-	-
	Total product inputs	-	50.0	37.7	-	16.8	92.9	10.2	0.2
	Total inputs	-	50.0	1 174.6	15.8	16.8	92.9	10.2	0.2

	Output (supply)								
	Product outputs								
	Energy carriers	-	49.7	206.2	15.6	-	92.7	6.4	-
	Other products	-	-	-	-	16.5	-	0.3	-
	Total product outputs	-	49.7	206.2	15.6	16.5	92.7	6.7	-
	Residual outputs								
	Mining overburden	-	-	958.0	0.1	-	-	-	-
	Other materials	-	0.1	9.1	-	0.3	-	3.5	0.2
	Air emissions	-	0.2	1.3	0.1	-	0.2	-	-
	Total residual outputs	-	0.3	968.4	0.2	0.3	0.2	3.5	0.2
	Total outputs	-	50.0	1 174.6	15.8	16.8	92.9	10.2	0.2
	Combustion								
	Input (uses)								
	Raw material inputs								
	Oxygen	249.2	0.6	5.7	1.6	26.8	16.4	266.3	205.0
	Total raw material inputs	249.2	0.6	5.7	1.6	26.8	16.4	266.3	205.0
	Product inputs								
2	Prod. of agriculture, forestry, fishing	0.2	-	-	-	-	-	0.3	2.4
4	Gases	9.1	0.2	-	-	3.9	0.7	19.0	13.7
6	Coale, coke and mine gas	142.8	-	1.1	-	3.3	-	16.7	2.5
8	Crude oil, natural gas	0.1	-	-	0.5	0.4	-	0.7	-
10	Refined petroleum products	3.2	-	-	-	1.4	3.9	43.9	42.8
16	Blast furnace gas	2.2	-	0.8	-	-	-	3.1	-
	Total product inputs	157.7	0.2	1.9	0.5	9.0	4.6	83.7	61.3
	Residual inputs								
	Waste for incineration	-	-	-	-	0.7	-	11.7	-
	Total residual inputs	-	-	-	-	0.7	-	11.7	-
	Total inputs	406.9	0.8	7.6	2.1	36.4	21.0	361.7	266.3
	Output (supply)								
	Residual outputs								
	Ashes, slags, dusts, etc	11.8	-	0.2	0.1	0.7	-	5.8	0.3
	Steam/water vapour	128.3	0.3	1.4	0.9	13.2	7.6	102.1	84.7
	Air emissions	266.8	0.5	6.0	1.1	22.6	13.4	253.8	181.3
	Total residual outputs	406.9	0.8	7.6	2.1	36.4	21.0	361.7	266.3
	Total outputs	406.9	0.8	7.6	2.1	36.4	21.0	361.7	266.3

Germany 1990

In Table 12.5, energy balances for Germany 1990 are also presented in calorific values. Such a presentation especially allows a description of processes of electricity generation (e.g. from hydropower or in nuclear power plants). The table also provides some information about the actual energy used and the energy losses connected with transforming and combusting energy.

Table 12.5: Physical input and output table for energy content

Energy content in calorific values (Petajoule)

Product type number	Materials	Composite branches of production							Consumption activities of households
		Electricity generation and distribution, steam, hot water	Gas production and distribution	Extraction of coal, manufacture of coal mining products	Extraction of crude oil and natural gas	Manufacturing of chemical products, fissile and fetile material	Manufacturing of refined petroleum products	Other branches of production	
		3	4	6	8	9	10	1, 2, 5, 7, 11-59	
	Inputs (uses)								
	Raw material inputs								
	Energy carriers		-	-	3 006.9	644.9	-	-	-
	Energy from hydropower		149.4	-	-	-	-	-	-
	Total raw material inputs		149.4	-	3 006.9	644.9	-	-	-
	Product inputs								
2	Prod.of agriculture, forestry, fishing	2.6	-	-	-	-	-	4.1	35.0
3	Electric power, steam, hot water	121.7	0.3	46.5	1.7	166.1	23.5	909.5	449.8
4	Gases	376.7	28.0	0.4	-	216.0	27.0	796.1	565.8
6	Coale, coke and mine gas	2 202.1	45.0	863.6	-	165.3	-	664.1	59.3
8	Crude oil, natural gas	3.3	1 981.7	-	18.8	18.6	3 218.3	29.5	-
9	Chemical prod. (incl. nuclear fuel	1 383.0	-	3.6	-	-	42.4	-	-
10	Refined petroleum products	134.2	2.5	31.4	0.2	612.0	897.0	2 030.7	1 854.3
16	Blast furnace gas	57.6	-	20.2	-	-	-	79.0	-
56	Environmental protection services	-	27.5	-	-	-	-	-	-
	Total product inputs	4 281.2	2 085.0	965.6	20.7	1 178.1	4 208.1	4 512.9	2 964.2
	Waste for incineration	0.0	-	-	-	4.2	0.1	74.9	-
	Total inputs	4 430.6	2 085.0	3 972.5	665.6	1 182.2	4 208.3	4 587.8	2 964.2
	Outputs (supply)								
	Raw material outputs								
	Energy carriers	-	-	-	-	-	-	-	-
	Energy from hydropower	-	-	-	-	-	-	-	-
	Total raw material outputs	-	-	-	-	-	-	-	-
	Product outputs								
2	Prod.of agriculture, forestry, fishing	-	-	-	-	-	-	-	-
3	Electric power, steam, hot water	1 839.1	-	-	-	-	-	-	-
4	Gases	-	2 061.2	-	-	-	-	-	-
6	Coale, coke and mine gas	-	-	3 880.2	-	-	-	-	-
8	Crude oil, natural gas	-	-	-	644.9	-	-	-	-
9	Chemical prod. (incl. nuclear fuel	-	-	-	-	700.0	-	-	-
10	Refined petroleum products	-	-	-	-	-	3 962.9	-	-
16	Blast furnace gas	-	-	-	-	-	-	177.5	-
56	Environmental protection services	-	-	-	-	-	-	-	-
	Total product outputs	1 839.1	2 061.2	3 880.2	644.9	700.0	3 962.9	177.5	-

	Waste for incineration	-	-	-	-	-	-	-	-
	Useful energy	54.3	5.0	67.6	12.0	268.4	127.5	1 956.1	1 433.6
	Energy losses	2 537.3	18.8	24.7	8.7	213.9	117.8	2 454.2	1 530.6
	Total outputs	4 430.6	2 085.0	3 972.5	665.6	1 182.2	4 208.3	4 587.8	2 964.2

Germany 1990

In Table 12.6, total air emissions are subdivided by 59 branches and by 6 types of air pollution. In addition, these types are weighted according to global warming potential and acidification respectively. The weighted data reveal the differing importance of the branches as polluter according to the different types of impacts analysed.

Table 12.6: Air emissions

Ser. Nr.	Origin	Air emissions								Air emissions weighted according to			
		Carbon dioxide CO_2	Nitrogen oxides NO_x	Sulphur dioxide SO_2	Nitrogen dioxide N_2O	Methene CH_4	Other	Total	Per-cent	Global warming potential [1]		Acidification [2]	
		1 000 tons							%	1000 t	%	1000 t	%
1	Agriculture	31 503	104	8	56	1 510	222	33 403	4.1	86 351	9.3	80	3.1
2	Forestry and fishing etc	2 324	3	2	-	-	7	2 336	0.3	2 345	0.3	5	0.2
3	Electricity, steam, hot water supply	266 041	328	324	3	6	70	266 769	32.9	267 104	28.6	553	21.1
4	Gas supply	452	1	-	-	182	1	637	0.1	4 921	0.5	1	0.0
5	Water supply	117	1	-	-	-	1	119	0.0	119	0.0	1	0.0
6	Coal mining	5 963	19	21	-	1 122	151	7 276	0.9	33 513	3.6	34	1.3
7	Other mining (excl. coal mining, crude petroleum, natural gas)	822	1	1	-	-	1	826	0.1	831	0.1	2	0.1
8	Extraction of crude petroleum, natural gas	1 063	1	20	-	47	-	1 132	0.1	2 230	0.2	21	0.8
9	Man. of chemical products (incl. nuclear fuel)	22 429	47	88	77	2	2 093	24 738	3.0	47 132	5.1	122	4.7
10	Man. of refined petroleum products	13 263	24	87	-	3	210	13 588	1.7	13 478	1.4	104	4.0
11	Man. of plastic products	1 590	3	2	-	-	2	1 598	0.2	1 606	0.2	4	0.2
12	Man. of rubber products	974	2	2	-	-	1	979	0.1	985	0.1	3	0.1
13	Quarrying of stones and clays, man. of building material, etc.	17 149	90	18	1	2	201	17 459	2.2	17 400	1.9	80	3.1
14	Man. of ceramic products	1 226	4	-	-	-	20	1 251	0.2	1 239	0.1	4	0.1
15	Man. of glass and glass products	4 191	31	25	-	-	35	4 282	0.5	4 236	0.5	47	1.8
16	Man. of iron and steel	46 998	35	56	2	3	4 575	51 669	6.4	47 646	5.1	80	3.1
17	Man. of non-ferrous metals, semifinished products thereof	3 141	5	12	-	-	116	3 274	0.4	3 178	0.3	15	0.6
18	Man. of foundry products	2 721	2	3	-	-	82	2 808	0.3	2 759	0.3	4	0.2
19	Man. of drawing plants products, cold rolling mills etc.	1 682	3	1	-	-	317	2 003	0.2	1 698	0.2	3	0.1
20	Man. of structural metal products, rolling stock	923	3	1	-	-	585	1 512	0.2	933	0.1	3	0.1
21	Man. of machinery and equipment (excl. electrical)	4 046	15	4	-	-	260	4 326	0.5	4 090	0.4	15	0.6
22	Man. of office machinery, autom. data processing equipment	189	-	-	-	-	3	192	0.0	191	0.0	-	0.0
23	Man. of road vehicles	4 038	10	3	-	-	344	4 397	0.5	4 081	0.4	10	0.4
24	Building of ships, boats and floating structures	144	-	-	-	-	431	575	0.1	146	0.0	-	0.0
25	Man. of aircraft and spacecraft	188	-	-	-	-	140	328	0.0	190	0.0	1	0.0
26	Man. of electrical machinery, equipment and appliances	3 311	11	4	-	-	77	3 404	0.4	3 347	0.4	12	0.5
27	Man. of precision and optical instruments, clocks and watches	407	2	-	-	-	7	416	0.1	412	0.0	2	0.1
28	Man. of tools and finished metal products	1 917	4	2	-	-	65	1 990	0.2	1 936	0.2	5	0.2
29	Man.of musical instruments, games and toys, sports goods, etc.	171	1	-	-	-	5	177	0.0	173	0.0	1	0.0
30	Man. of wood	1 785	3	3	-	-	7	1 799	0.2	1 799	0.2	6	0.2
31	Man. of wood products	2 144	13	2	-	-	54	2 214	0.3	2 165	0.2	11	0.4
32	Man. of pulp, paper and -board	7 463	10	24	-	1	17	7 515	0.9	7 547	0.8	32	1.2
33	Man. of paper and -board products	1 165	3	2	-	-	29	1 198	0.1	1 178	0.1	4	0.1
34	Printing and duplicating	743	3	-	-	-	76	822	0.1	751	0.1	2	0.1
35	Man. of leather and leather products, footwear	216	1	1	-	-	2	219	0.0	219	0.0	1	0.0

36	Man. of textiles	2 818	5	7	-	-	6	2 836	0.3	2 850	0.3	11	0.4
37	Man. of wearing apparel	483	2	1	-	-	6	492	0.1	488	0.1	2	0.1
38	Man. of food products (excl. beverages)	10 564	36	22	-	1	62	10 686	1.3	10 681	1.1	47	1.8
39	Man. of beverages	2 793	19	4	-	-	16	2 833	0.3	2 821	0.3	17	0.7
40	Man. of tobacco products	131	1	-	-	-	-	132	0.0	133	0.0	1	0.0
41	Construction (excl. installation and building completion)	5 334	61	5	-	1	102	5 502	0.7	5 400	0.6	48	1.8
42	Installation and building completion	2 076	16	2	-	-	747	2 841	0.3	2 105	0.2	13	0.5
43	Wholesale trade, etc., recycling	10 679	129	10	-	1	143	10 962	1.4	10 800	1.2	100	3.8
44	Retail trade	9 869	65	7	-	2	170	10 113	1.2	9 990	1.1	52	2.0
45	Railway transport	1 966	24	2	-	-	19	2 010	0.2	1 987	0.2	19	0.7
46	Water transport, ports	8 985	34	3	-	-	141	9 164	1.1	9 012	1.0	27	1.0
47	Post and telecommunication	1 155	7	1	-	-	13	1 175	0.1	1 167	0.1	6	0.2
48	Transport activities n.e.c.	33 099	307	20	1	2	233	33 661	4.1	33 417	3.6	235	9.0
49	Banking	1 044	3	1	-	-	12	1 060	0.1	1 055	0.1	3	0.1
50	Insurance (excl. social security funds)	554	1	-	-	-	6	561	0.1	560	0.1	1	0.1
51	Renting of real estate	218	-	-	-	-	-	219	0.0	220	0.0	-	0.0
52	Hotels and restaurants, homes and hostels	2 776	6	2	-	-	1 821	4 607	0.6	2 806	0.3	7	0.3
53	Education, research, cultural services and publishing	1 058	3	1	-	-	15	1 078	0.1	1 069	0.1	3	0.1
54	Health and veterinary market service activities	1 453	6	1	-	-	32	1 493	0.2	1 472	0.2	5	0.2
55	Other market service activities, etc	6 869	47	4	-	2	226	7 147	0.9	6 978	0.7	36	1.4
56	External environmental protection services	12 257	9	7	-	1 407	19	13 700	1.7	46 730	5.0	14	0.5
57	Central and local government	11 436	38	12	1	1	53	11 538	1.4	11 670	1.3	38	1.4
58	Social security funds	463	4	-	-	-	10	477	0.1	469	0.1	3	0.1
59	Private non-profit institutions, private households	2 356	5	2	-	-	15	2 379	0.3	2 378	0.3	6	0.2
60	Total industries	582 939	1 614	832	143	4 300	14 080	603 903	74.4	734 187	78.7	1 962	74.8
61	Household consumption activities	194 910	803	98	5	97	11 840	207 752	25.6	198 868	21.3	660	25.2
62	Total	777 849	2 417	930	148	4 397	25 920	811 655	100.0	933 055	100.0	2 622	100.0

1) Weighting factors : CO_2 = 1, N2O = 320 and CH_4 = 24.5

2) Weighting factors: SO_2 = 1 and NO_x = 0.7

Germany 1990

12.3 Disaggregation of expenditure

An elaborate supply and use system is based on the disaggregation of expenditure for several final use categories. Also, a disaggregation of final consumption expenditure of households by products and individual purposes of consumption is as important as the disaggregation of final consumption expenditure by government, by product, and by main functions of the government. Finally, the disaggregation of gross fixed capital formation by product and investing industry is required for the compilation of capital stock data. The same information on investment is also required for the calculation of the valuation matrix for non-deductible VAT.

In the SNA 1993, a special chapter has been addressed to functional classifications. These classifications comprise:

- a classification of individual consumption by purpose (COICOP),
- a classification of the functions of the government (COFOG),

- a classification of the purposes of non-profit institutions serving households (COPNI), and
- a classification of outlays of producers by purpose (COPP).

These classifications identify the "functions" - in the sense of "purposes" or "objectives" - for which the actors engage in certain transactions (SNA 1993, par. 18.1). There is a wide variety of *analytical uses*. For example, the classification of individual consumption by purpose shows household expenditure on food, health and education services all of which are important indicators of national welfare; the classification of the functions of government shows government expenditure on health and education services as well as on defence and prison services; the classification of outlays of producers by purpose provide information on ancillary activities which might deliver important services to the associated unit (see ESA 1995, par. 3.12).

Table 12.7 gives examples of purposes of expenditures which are common to more than one classification:

Table 12.7: Examples of purposes of expenditure common to more than one classification

Purpose of expenditure	COICOP	COPNI	COFOG	COPP
Health	x	x	x	x
Recreation	x	x	x	x
Culture	x	x	x	x
Education	x	x	x	x
Social protection	x	x	x	x
Environmental protection	-	x	x	x
Research and development	-	x	x	x
Housing	x	x	x	-
Transport	x	-	x	x
Communication	x	-	x	x
Disaster relief	-	x	x	-
Economic aid abroad	-	x	x	-
Religion	-	x	x	-

After cooperation between various international organisations, the four classifications of expenditure according to purpose have been elaborated in detail (United Natons 2000a). This document can now also be used as a suitable conceptual base for functional classifications in the input-output framework.

In the ESA 1995, no special emphasis is given to functional classifications. The COICOP and COFOG are mentioned in the context of supplementary information to the use table of the input-output framework (ESA 1995, par. 9.51); special reference is given to the COFOG for defining the borderline between individual and collective goods and services (ESA 1995, par. 3.85). Furthermore, COICOP and COFOG are listed in the annex (ESA 1995, pp. 300 – 302).

Table 12.8: Disaggregation of expenditure

Use table

	INDUSTRIES (NACE) / PRODUCTS (CPA)	INPUT OF INDUSTRIES				FINAL USES									
		Agriculture	..	Other services	Total	Final consumption by households	Final consumption by non-profit organisations	Final consumption by government	Gross fixed capital formation	Changes in valuables	Changes in inventories	Exports intra EU FOB	Exports extra EU FOB	Total	Total use at purchasers' prices
No		1		59	60	61	62	63	64	65	66	67	68	69	70
1	Products of agriculture														
:	:														
59	Other services														
60	Total														
61	CIF/FOB adjustments exports														
62	Purchases abroad by residents														
63	Dom. Purch. by non-residents														
64	Total														
65	Compensation of employees														
66	Other net taxes on production														
67	Consumption of fixed capital														
68	Operating surplus, net														
69	Value added at basic prices														
70	Output at basic prices														

Final consumption expenditure by households

	COICOP / PRODUCTS (CPA)	CLASSIFICATION OF INDIVUAL CONSUMPTION BY PURPOSE										
		Food, beverages and tobacco	Clothing and footwear	Housing, water, electricty	Furnishings, household equipment	Health	Transport	Leisure, entertainment and culture	Education	Hotels, cafes and restaurants	Miscellaneous goods and servces	Total
No		1	2	3	4	5	6	7	8	9	10	11
1	Products of agriculture											
:	:											
59	Other services											
60	Total											

Final consumption expenditutre by government

	COFOG / PRODUCTS (CPA)	CLASSIFICATION OF THE FUNCTIONS OF GOVERNMENT										
		General public service	Defence affairs and services	Public order and seafety affairs	Education affairs and services	Health affairs and services	Social security and welfare affairs	Housing, community amenity affairs	Recreational, cultural and religious affairs	..	Other economic affairs and services	Total
No		1	2	3	4	5	6	7	8		14	15
1	Products of agriculture											
:	:											
59	Other services											
60	Total											

Gross fixed capital formation

	INDUSTRIES (NACE) / PRODUCTS (CPA)	INVESTING INDUSTRIES										
		Agriculture, hunting	Forestry, logging	Fishing	Mining of coal and lignite	Extraction of crude oil and natura gas	Mining of uranium	Mining of metal ores	Other mining and quarrying	..	Private households	Total
No		1	2	3	4	5	6	7	8		59	60
1	Products of agriculture											
:	:											
59	Other services											
60	Total											

Table 12.9: Individual consumption by purpose, functions of government, investment by industry

Final consumption expenditure by households at purchasers' prices

Billions of HUF

	COICOP / PRODUCTS (CPA)	CLASSIFICATION OF INDIVIDUAL CONSUMPTION BY PURPOSE												
		Food and non-alcoholic beverages	Alcoholic beverages, tobacco and narcotics	Clothing and footwear	Housing, water, electricity, gas and other fuels	Furnishings, household equipment and maintenance	Health	Transport	Communication	Recreation and culture	Education	Restaurants and hotels	Miscellaneous goods and services	Total
No		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Products of agriculture	316	31		16					26				389
2	Products of industry	1 639	855	419	747	758	198	1 322	22	472			171	6 601
3	Construction work				37									37
4	Trade hotel, transport services			9		27		323	460	99		554	5	1 477
5	Private services			2	1 178	7		14		20			422	1 643
6	Other services		87	4	92	17	203	44		244	134		268	1 093
7	Total	1 955	973	434	2 070	809	402	1 702	482	861	134	554	865	11 241
8	CIF/FOB adjustments on exports													
9	Purchases abroad by residents													537
10	Domestic purch. by non-residents													- 771
11	Total													11 777

Final consumption expenditure by government

	COICOP / PRODUCTS (CPA)	CLASSIFICATION OF THE FUNCTIONS OF GOVERNMENT										
		General public services	Defence	Public order and safety	Economic affairs	Environmental protection	Housing and community amenities	Health	Recreation, culture and religion	Education	Social protection	Total
No		1	2	3	4	5	6	7	8	9	10	11
1	Products of agriculture				19							19
2	Products of industry							345	1		47	394
3	Construction work				6							6
4	Trade hotel, transport services				41					67	104	212
5	Private services	27			35	13	50		5	35		164
6	Other services	916	347	409	95	22	42	714	183	898	218	3 842
7	Total	943	347	409	195	34	92	1 059	189	999	368	4 637

Gross fixed capital formation by industry

No	INDUSTRIES (NACE) / PRODUCTS (CPA)	INVESTING INDUSTRIES (NACE) Agriculture	Industry	Construction	Trade, hotel, transport	Private services	Other services	Total
No		1	2	3	4	5	6	7
1	Products of agriculture	55	2					57
2	Products of industry	84	877	62	504	172	167	1 866
3	Construction work	41	346	51	283	956	558	2 235
4	Trade hotel, transport services							
5	Private services	2	62	6	96	290	35	490
6	Other services						2	2
7	Total	182	1 286	119	883	1 418	762	4 651

Hungary 2004

Table 12.8 repeats the flow chart for the disaggregation of expenditure in the supply and use system from Figure 5.1 in Chapter 5 (The use table). Table 12.9 gives an empirical example for an actual compilation of separate supplementary matrices for final consumption of households, final consumption by government and gross fixed capital formation.

12.3.1 Final consumption expenditures by purpose

The three classifications COICOP, COPNI and COFOG, are closely linked with each other. The COICOP comprises all *individual consumption* expenditures independently of the sectoral origin which could be households, non-profit institutions serving households (NPISHs) or general government: The Divisions 01 to 12 refer to the individual consumption expenditure of households, Division 13 to the individual consumption expenditure of NPISHs and Division 14 to individual consumption expenditure of general government. The disaggregation by purpose in the Divisions 13 and 14 of COICOP replicates the purposes in the classifications for NPISHs (COPNI) and general government (COFOG). If the consumption expenditures of NPISHs and general government were classified according to COPNI and COFOG, they could easily be transferred directly into Divisions 13 and 14 of COICOP (see United Nations 2000a, par. 32 - 41). For compiling individual consumption by product and purpose, the correspondence table between COICOP 01 - 12 and the Central Product Classification (CPC) which is published by the OECD is helpful.

By convention, all consumption expenditures of NPISHs are treated as individual consumption. Thus, *all* consumption expenditures of NPISHs are described in COPNI as well as in Division 14 of COICOP.

In the case of classifying expenditures of general government by function (COFOG), only a part of the consumption expenditures of general government is defined as individual. Expenditures on general public services, defence, public order and safety, economic affairs, environmental protection as well as housing and community amenities are considered to be spent for the benefit of the community as a whole rather than for individual households. They are termed *collective consumption expenditures* and excluded from COICOP. COICOP Division 14 identifies those government expenditures that are regarded as individual and classifies them by purpose, namely, health, education, social protection, recreation and culture (United Nations 2000a, par. 15).

In the input-output framework (ESA 1995, Chapter 9), the concept of *final consumption expenditure* is used (ESA 1995, par. 3.74). According to this concept, final consumption is shown in a cross-classification by product (CPA) and by sector (households, NPISHs, government). For describing the transition to the concept of *actual final consumption* (ESA 1995, par. 3.81) which comprises a distinction between individual and collective consumption, the three classifications of final expenditure by purpose (COFOG, COICOP and COPNI) are used. In a first step, the sectoral information on final expenditures is extended to three matrices showing the expenditures in a cross-classification by product (CPA) and by purpose (households: COFOG, NPISHs: COPNI and government: COFOG). In a second step, the three matrices can be merged into one matrix which shows final consumption cross-classified by product (CPA) and by purpose. The classification by purpose has two parts: purposes which could be associated with actual individual consumption and purposes which refer to actual collective consumption. It seems to be useful to subdivide the matrix and to show two columns of subtotals for individual and collective consumption respectively and - of course - the totals of final consumption. They are calculated as row sums of the matrix.

The revised NACE has diminished the importance of a breakdown of final consumption of government and NPISHs according to functions in the input-output framework. Activities of non-market institutions are already allocated among the different branches by type of services which correspond with the functions of these institutions. According to this treatment, final consumption expenditure is disaggregated by type of services revealing their purposes in the second quadrant of the use table. Nevertheless, COFOG can be used to show at least a breakdown of government services by individual and collective consumption, which implies two columns of final consumption expenditures by government in input-output tables. In the case of NPISHs, no breakdown by individual and collective consumption is necessary because all services are treated as individual consumption.

Table 12.10 gives an example for presenting individual consumption expenditures in a breakdown by product group (CPA) and by purpose. The example refers to Germany 1997 based on the concepts of ESA 1995. The table has been compiled by adding three matrices according to the different types of sector (households, NPISHs and general government). The totals of the sectoral individual consumption by product group and purpose respectively are given as memorandum items. The purpose classification used has been derived from the suggested presentation of COICOP statistics in matrix form (United Nations 2000a, par. 39, Table 3.1). This presentation merges the COICOP classification of households (01 - 12) with those of NPISHs (13.1 - 13.6) and government (14.1 - 14.5).

Table 12.10: Individual consumption expenditures

Millions of Deutsche Mark

No.	P60	COICOP / CPA	Food, non-alcoholic beverages 01	Alcoholic beverages and tobacco 02	Clothing and footwear 03	Housing, water, elecricity, gas and other fuels 04 13.2, 14.1	Furnishings, household equipment and routine maintenance of the house 05	Health 06 13.2, 14.2	Transport 07	Communications 08	Leisure, entertainment and culture 09 13.3, 14.3
			1	2	3	4	5	6	7	8	9
1	1	Products of agriculture, hunting and related services	21 182	2 946	-	537	-	-	-	-	12 642
2	2	Products of forestry, logging and related services	-	-	-	1 506	-	-	-	-	522
3	5	Fish and other fishing products, services incidental to fishing	317	-	-	-	-	-	-	-	-
4	10	Coal and lignite; peat	-	-	-	2 103	-	-	-	-	194
5	11	Crude petroleum and natural gas	-	-	-	18 065	-	-	-	-	-
6	12	Uranium and thorium ores	-	-	-	-	-	-	-	-	-
7	13	Metal ores	-	-	-	-	-	-	-	-	-
8	14	Other mining and quarrying products	168	-	-	-	-	-	-	-	30
9	15	Food products and beverages	221 912	37 064	-	-	-	-	-	-	4 904
10	16	Tobacco products	-	37 234	-	-	-	-	-	-	-
11	17	Textiles	-	-	17 917	-	18 403	93	-	-	231
12	18	Wearing apparel; furs	-	-	95 690	-	100	-	-	-	-
13	19	Leather and leather products	-	-	18 181	-	-	56	-	-	1 137
14	20	Wood and products of wood and cork (except furniture)	-	-	-	1 321	1 718	-	-	-	27
15	21	Pulp, paper and paper products	-	116	-	414	782	-	-	-	403
16	22	Printed matter and recorded media	-	-	-	-	-	-	-	-	40 939
17	23	Coke, refined petroleum products and nuclear fuel	-	-	-	17 055	-	-	62 105	-	-
18	24	Chemicals, chemical products and man-made fibres	31	-	-	1 589	7 222	18 058	268	-	2 030
19	25	Rubber and plastic products	-	-	494	671	7 280	738	4 762	-	728
20	26	Other non-metallic mineral products	-	-	-	1 583	8 469	-	-	-	-

21	27	Basic metals	-	-	-	-	-	-	-	-	-
22	28	Fabricated metal products, except machinery and equipment	-	-	-	529	10 623	-	198	-	298
23	29	Machinery and equipment n.e.c.	-	-	-	1 249	22 814	6	17	-	109
24	30	Office machinery and computers	-	-	-	-	-	-	-	-	5 116
25	31	Electrical machinery and apparatus n.e.c.	-	-	-	-	3 886	-	375	-	-
26	32	Radio, television and communication equipment and apparatus	-	-	-	-	-	-	-	810	17 645
27	33	Medical, precision and optical instruments, watches and clocks	-	-	-	-	8	7 917	-	-	2 368
28	34	Motor vehicles, trailers and semi-trailers	-	-	-	-	-	-	113 123	-	1 734
29	35	Other transport equipment	-	-	-	-	-	32	8 074	-	595
30	36	Furniture; other manufactured goods n.e.c.	-	-	-	-	56 570	-	-	-	15 564
31	37	Recovered secondary raw materials	-	-	-	-	-	-	-	-	-
32	40	Electrical energy, gas, steam and hot water	-	-	-	42 240	-	-	-	-	-
33	41	Collected and purified water, distribution services of water	-	-	-	8 628	-	-	-	-	-
34	45	Construction work	-	-	-	8 016	1 264	-	-	-	-
35	50	Trade, maintenance and repair services of motor vehicles etc.	-	-	-	-	-	-	41 274	-	-
36	51	Wholesale tade and vehicles etc.	-	-	-	-	-	-	-	-	-
37	52	Retail trade services, except of motor vehicles etc.	-	-	1 756	-	1 937	-	1 394	-	1 386
38	55	Hotel and restaurant services	-	-	-	-	-	-	-	-	-
39	60	Land transport and transport via pipeline services	-	-	-	-	-	-	24 902	-	-
40	61	Water transport services	-	-	-	-	-	-	540	-	-
41	62	Air transport services	-	-	-	-	-	-	8 340	-	6 792
42	63	Supporting and auxiliary transport services; travel agency services	-	-	-	-	-	-	5 349	-	9 718
43	64	Post and telecommunication services	-	-	-	-	-	-	-	43 300	4 832
44	65	Financial intermediation serv., excl. insurance and pension funding services	-	-	-	-	-	-	-	-	-
45	66	Insurance and pension funding services	-	-	-	7 899	-	-	-	-	-
46	67	Services auxiliary to financial intermediation	-	-	-	-	-	-	-	-	-
47	70	Real estate services	-	-	-	355 162	-	-	5 747	-	-
48	71	Renting services of machinery and equipment	-	-	44	-	179	-	6 897	-	2 664
49	72	Computer and related services	-	-	-	-	-	-	-	-	199
50	73	Research and development services	-	-	-	-	-	-	-	-	-
51	74	Other business services	-	-	3	2 066	699	-	2 100	-	1 355
52	75	Public admin.and defence services; compulsory social security services	-	-	-	-	-	203	876	-	68
53	80	Education services	-	-	-	-	-	-	3 769	-	-
54	85	Health and social work services	-	-	-	-	-	244 107	-	-	598
55	90	Sewage and refuse disposal services, sanitation and similar services	-	-	-	23 377	-	-	-	-	-
56	91	Membership organisation services n.e.c.	-	-	-	-	-	-	-	-	3 427
57	92	Recreational, cultural and sporting services	-	-	-	-	15	-	-	-	57 781
58	93	Other services	-	-	2 045	-	228	-	-	-	4 906
59	95	Private households with employed persons	-	-	-	-	4 463	-	-	-	-
60		Total	243 610	77 360	136 130	494 010	146 660	271 210	290 110	44 110	200 942
61		Households	243 610	77 360	136 130	490 050	146 660	80 880	290 110	44 110	185 250
62		NPISHS	-	-	-	-	-	-	-	-	3 352
63		General government	-	-	-	3 960	-	190 330	-	-	12 340

Germany 1990

Table 12.10: Individual consumption expenditures *(continued)*

Millions of Deutsche Mark

No.	P60	COICOP / CPA	Educa-tion 10 13,4, 14.4	Hotels, cafes and restau-rants 11	Miscel-laneous gods and services 12 less 12.4	Social protec-tion 12,4 13.5, 14.5	Other services 13,6	Total	House-holds	NPISHS	Genera govern-ment
			10	11	12	13	14	15	16	17	18
1	1	Products of agriculture, hunting and related services	-	-	-	-	-	37 307	37 262	-	45
2	2	Products of forestry, logging and related services	-	-	-	-	-	2 028	2 028	-	-
3	5	Fish and other fishing products, services incidental to fishing	-	-	-	-	-	317	317	-	-
4	10	Coal and lignite; peat	-	-	-	-	-	2 297	2 297	-	-
5	11	Crude petroleum and natural gas	-	-	-	-	-	18 065	17 907	-	158
6	12	Uranium and thorium ores	-	-	-	-	-	-	-	-	-
7	13	Metal ores	-	-	-	-	-	-	-	-	-
8	14	Other mining and quarrying products	-	-	2	-	-	200	200	-	-
9	15	Food products and beverages	-	2 089	-	792	-	266 761	265 969	-	792
10	16	Tobacco products	-	-	-	-	-	37 234	37 234	-	-
11	17	Textiles	-	-	93	145	-	36 882	36 737	-	145
12	18	Wearing apparel; furs	-	-	-	2	-	95 792	95 790	-	2
13	19	Leather and leather products	-	-	5 753	29	-	25 156	25 127	-	29
14	20	Wood and products of wood and cork (except furniture)	-	-	356	-	-	3 422	3 282	-	140
15	21	Pulp, paper and paper products	-	-	6 975	-	-	8 690	8 678	-	12
16	22	Printed matter and recorded media	-	-	662	-	-	41 601	41 601	-	-
17	23	Coke, refined petroleum products and nuclear fuel	-	-	-	-	-	79 160	78 660	-	500
18	24	Chemicals, chemical products and man-made fibres	-	-	16 135	38 677	-	84 010	45 282	-	38 728
19	25	Rubber and plastic products	-	-	64	-	-	14 737	14 737	-	-
20	26	Other non-metallic mineral products	-	-	2 537	-	-	12 589	12 589	-	-
21	27	Basic metals	-	-	-	-	-	-	-	-	-
22	28	Fabricated metal products, except machinery and equipment	-	-	1 653	-	-	13 301	13 225	-	76
23	29	Machinery and equipment n.e.c.	-	-	1 018	-	-	25 213	25 131	-	82
24	30	Office machinery and computers	-	-	-	-	-	5 116	5 116	-	-
25	31	Electrical machinery and apparatus n.e.c.	-	-	-	70	-	4 331	4 261	-	70
26	32	Radio, television and communication equipment and apparatus	-	-	-	78	-	18 533	18 455	-	78
27	33	Medical, precision and optical instruments, watches and clocks	-	-	4 025	8 433	-	22 751	14 318	-	8 433
28	34	Motor vehicles, trailers and semi-trailers	-	-	-	-	-	114 857	114 857	-	-
29	35	Other transport equipment	-	-	-	309	-	9 010	8 701	-	309
30	36	Furniture; other manufactured goods n.e.c.	-	-	11 243	237	-	83 614	83 377	-	237
31	37	Recovered secondary raw materials	-	-	-	-	-	-	-	-	-
32	40	Electrical energy, gas, steam and hot water	-	-	-	-	-	42 240	41 640	-	600
33	41	Collected and purified water, distribution services of water	-	-	-	-	-	8 628	8 628	-	-
34	45	Construction work	-	-	-	-	-	9 280	7 968	-	1 312
35	50	Trade, maintenance and repair services of motor vehicles etc.	-	-	-	-	-	41 274	41 274	-	-

Millions of Deutsche Mark

No.	P60	COICOP / CPA	Educa-tion 10 13,4, 14.4	Hotels, cafes and restau-rants 11	Miscel-laneous gods and services 12 less 12.4	Social protec-tion 12,4 13.5, 14.5	Other services 13,6	Total	House-holds	NPISHS	Genera govern-ment
			10	11	12	13	14	15	16	17	18
36	51	Wholesale trade and vehicles etc.	-	-	-	-	-	-	-	-	-
37	52	Retail trade services, except of motor vehicles etc.	-	-	376	-	-	6 849	6 849	-	-
38	55	Hotel and restaurant services	-	100 954	-	151	-	101 105	100 954	-	151
39	60	Land transport and transport via pipeline services	-	-	-	-	-	24 902	24 902	-	-
40	61	Water transport services	-	-	-	-	-	540	540	-	-
41	62	Air transport services	-	-	-	-	-	15 132	15 132	-	-
42	63	Supporting and auxiliary transport services; travel agency services	-	-	170	-	-	15 237	15 237	-	-
43	64	Post and telecommunication services	-	-	-	109	-	48 241	48 132	-	109
44	65	Financial intermediation serv., excl. insurance and pension funding services	-	-	13 497	-	-	13 497	13 497	-	-
45	66	Insurance and pension funding services	-	-	61 350	-	-	69 249	69 249	-	-
46	67	Services auxiliary to financial intermediation	-	-	827	-	-	827	827	-	-
47	70	Real estate services	-	-	3 936	-	-	364 845	364 061	-	784
48	71	Renting services of machinery and equipment	-	-	-	2 590	-	12 374	9 784	-	2 590
49	72	Computer and related services	-	-	-	-	-	199	199	-	-
50	73	Research and development services	-	-	-	-	4 623	4 623	-	4 623	-
51	74	Other business services	-	-	8 546	-	-	14 769	14 569	-	200
52	75	Public admin.and defence services; compulsory social security services	-	-	5 638	120	-	6 905	6 785	-	120
53	80	Education services	148 306	-	1 646	465	-	154 186	19 793	15 428	118 965
54	85	Health and social work services	-	-	-	66 228	-	310 933	65 307	20 393	225 233
55	90	Sewage and refuse disposal services, sanitation and similar services	-	-	-	-	-	23 377	23 377	-	-
56	91	Membership organisation services n.e.c.	362	-	3	-	19 284	23 076	3 792	19 284	-
57	92	Recreational, cultural and sporting services	-	137	-	3 000	-	60 933	42 241	3 352	15 340
58	93	Other services	-	-	32 403	-	-	39 582	39 582	-	-
59	95	Private households with employed persons	-	-	-	-	-	4 463	4 463	-	-
60		Total	148 668	103 180	178 908	121 435	23 907	2 480 240	2 001 920	63 080	415 240
61		Households	14 740	103 180	178 908	10 932	-	2 001 920	2001 920	-	-
62		NPISHS	15 428	-	-	20 393	23 907	63 080	-	63 080	-
63		General government	118 500	-	-	90 110	-	415 240	-	-	415 240

Germany 1990

COICOP gives additional information on the *type of product* (United Nations 2000, par. 49 and 50). Classes containing goods are devoted by ND (non-durable), SD (semi-durable) and D (durable), S devotes classes consisting of services. The distinction between non-durable and durable goods is based on the question of whether the goods can be used only once or repeatedly or continuously over a period of considerably more than one year (SNA 1993, par. 9.38). Moreover, durables such as motor cars, refrigerators, washing machines and televisions, have a relatively high purchasers' price. Semi-durable goods differ from durable goods in that their expected lifetime of use, though more than one year, is often significantly shorter and their purchasers' price substantially less.

It is recommended that this additional denotation of COICOP is used to establish a matrix of final consumption by product (CPA) and type of product which could be used as data base for estimating the asset values of consumer durables. The breakdown by type of product is also very useful for calculating elasticities of final demand of consumption goods which are influenced by the durability of goods.

12.3.2 Outlays of producers by purpose

The classification of outlays of producers according to purpose (COPP) refers to production activities. Thus, such classification could be used in the input-output framework to disaggregate the inputs of industries (branches). Such breakdown could aim at identifying the intermediate and primary inputs of *ancillary activities* of the producers.

An ancillary activity is not undertaken for its own sake but purely in order to provide supporting services for principal or secondary activities. Therefore, both SNA and ISIC treat ancillary activities as integral parts of the principal or secondary activities with which they are associated (SNA 1993, par. 5.13). Typical ancillary activities that may be carried out are transporting, storing, marketing, various kinds of financial and business services, computing, communications, training, security, maintenance, etc. (United Nations 2000a, par. 65.

Although the central framework of the SNA does not demand information about ancillary activities, it is necessary to obtain the information for specialised *satellite studies* in which ancillary activities often play an important role. Typical examples may be studies on research and development, environment, education, health and so forth (SNA 1993 par. 21.17 and 21.36 - 21.38).

The COPP can be used to achieve a matrix of inputs by type of inputs (intermediate products, primary inputs like consumption of fixed capital and compensation of employees) and by purpose (COPP) for each industry (branch). Such matrices would establish a *third dimension* of the presentation of inputs in the input-output framework. The row totals of these matrices correspond with the columns of industries in the use table and of branches in the symmetric input-output table respectively.

According to the SNA 1993, ancillary activities are only connected with costs but they have no gross output. For disaggregating the inputs of industries (branches) by purpose, the whole amount of gross output and operating surplus has to be associated with the current production activity (Division 06 of COPP). The other purposes (Divisions 01 to 05 of COPP) should have a zero gross output and a negative value of operating surplus which equals the total costs of the respective ancillary activity (purpose).

In the context of satellite analysis, the internal ancillary activities can be *externalised* (see SNA 1993, par. 21.17). In this case, the production boundary has to be extended. The additional output of externalised ancillary units corresponds with the total amount of costs associated with these activities. Such treatment follows the valuation concept of non-marketed services. The output is used as intermediate input of the industry (branch) the respective ancillary activity is associated with. The amount of total costs of this industry (branch) remains unchanged because the externalisation of ancillary activities leads to a corresponding reduction of costs. Thus, the operating surplus of this industry (branch) and the total value added of the economy will remain the same.

This concept of revealing the costs of ancillary activities has been applied in the case of *environmental protection expenditures*. In the System for Integrated Environmental and Economic Accounting (SEEA) of the United Nations (United Nations 1993), the procedure has been described in part B of chapter II (par. 111 - 138). The European System for the Collection of Economic Data on the Environment (SERIEE, see also Eurostat 1994) refers to the treatment of environmental protection activities in chapter X (par. 10025 to 10030). In the SNA 1993, the case of environmental protection activities is presented as an example in Part D of chapter XXI.

Table 12.11: Domestic output and expenditure on environmental protection

Millions of Deutsche Mark

Ser. No.	Uses / Supply	Input of branches											Total
		External environmental protection services					total other branches	of which					
		total	of which					excl. environ-mental protec-tion	Internal environmental protection services				
			waste	water	noise	air			waste	water	noise	air	
		1=2-5					6=7-11						12=1+6
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Output by commodity group:	**with internal environmental protection services**											
1	Agricultural, forestry and fishery products	-	-	-	-	-	57 970	57 970	-	-	-	-	57 970
2	Electricity, gas, water and products of mining	714	164	550	-	1	106 149	102 329	813	1 373	-	1 634	106 863
3	Chemicals and chemical products	119	11	107	-	0	109 377	108 473	169	423	-	312	109 496
4	Petroleum products	428	279	148	-	1	26 735	26 541	119	-	-	75	27 163
5	Plastic and non-metallic mineral products, etc.	119	96	22	-	-	96 238	96 238	-	-	-	-	96 357
6	Basic metals products	-	-	-	-	-	146 760	146 760	-	-	-	-	146 760
7	Machinery (except electr.) transport equipment	1 234	804	429	-	1	137 976	137 507	48	170	16	235	139 210
8	Electrical machinery, fabricated metal prod.etc.	144	84	60	-	-	111 125	111 010	12	42	4	57	111 269
9	Wood, paper, leather, textiles products	383	332	50	-	1	122 070	122 070	-	-	-	-	122 453
10	Food products, beverages and tobacco	-	-	-	-	-	73 669	73 669	-	-	-	-	73 669
11	Construction	1 838	1 030	807	-	1	47 772	47 772	-	-	-	-	49 610
12	Trade, transport and postal services, etc.	730	541	186	-	2	235 277	235 041	69	80	2	86	236 007
13	Other market services, excl.environmental protection services	1 065	934	121	-	10	658 464	658 464	-	-	-	-	659 529
14	External environmental protection services	4 915	4 312	603	-	-	11 456	11 456	-	-	-	-	16 371
15	Non-market services, excl. environmental protection services	1 250	786	461	-	3	77 227	77 227	-	-	-	-	78 477
16	**Intermediate consumption of domestic output excl. VAT**	12 939	9 374	3 545	-	20	2 018 265	2 012 528	1 230	2 088	21	2 398	2 031 204
17	Intermediate consumption of imports excl. VAT	748	479	268	-	1	341 431	340 456	225	328	4	417	342 179
18	Non-deductible VAT	987	632	353	-	2	27 253	27 192	54	7	-	-	28 240
19	Intermediate consumption total incl. VAT	14 674	10 485	4 166	-	23	2 386 949	2 380 176	1 510	2 422	25	2 816	2 401 623
20	Consumption of fixed capital	6 486	1 155	5 278	35	18	301 388	296 281	401	1 331	277	3 098	307 874
21	Taxes less susidies on production	-	-	-	-	-	73 440	73 440	-	-	-	-	73 440
22	Compensation of employees	6 173	4 358	1 815	-	-	1 309 347	1 304 867	482	1 696	104	2 198	1 315 520
23	Property and entrepreneurial income	-748	59	-807	-	-	552 115	568 475	- 2 393	- 5 450	-406	- 8 111	551 367
24	**Gross value added at market prices**	11 910	5 571	6 286	35	18	2 236 290	2 243 063	- 1 510	- 2 422	-25	- 2 816	2 248 200
25	**Output**	26 584	16 056	10 452	35	41	4 623 239	4 623 239	-	-	-	-	4 649 823
	with externalised environmental protection services												
1	Agricultural, forestry and fishery products	-	-	-	-	-	57 970	57 970	-	-	-	-	57 970
2	Electricity, gas, water and products of mining	714	164	550	-	1	106 149	102 329	813	1 373	-	1 634	106 863
3	Chemicals and chemical products	119	11	107	-	0	109 377	108 473	169	423	-	312	109 496
4	Petroleum products	428	279	148	-	1	26 735	26 541	119	-	-	75	27 163
5	Plastic and non-metallic mineral products, etc.	119	96	22	-	-	96 238	96 238	-	-	-	-	96 357
6	Basic metals products	-	-	-	-	-	146 760	146 760	-	-	-	-	146 760
7	Machinery (except electr.) transport equipment	1 234	804	429	-	1	137 976	137 507	48	170	16	235	139 210
8	Electrical machinery, fabricated metal prod.etc.	144	84	60	-	-	111 125	111 010	12	42	4	57	111 269
9	Wood, paper, leather, textiles products	383	332	50	-	1	122 070	122 070	-	-	-	-	122 453
10	Food products, beverages and tobacco	-	-	-	-	-	73 669	73 669	-	-	-	-	73 669
11	Construction	1 838	1 030	807	-	1	47 772	47 772	-	-	-	-	49 610
12	Trade, transport and postal services, etc.	730	541	186	-	2	235 277	235 041	69	80	2	86	236 007
13	Other market services, excl.environmental protection services	1 065	934	121	-	10	658 464	658 464	-	-	-	-	659 529

14	External environmental protection services	4 915	4 312	603	-	-	11 456	11 456	-	-	-	-	16 371
15	Externalised environmental protection services	-	-	-	-	-	16 360	16 360	-	-	-	-	16 360
16	Non-market services, excl. environmental protection services	1 250	786	461	-	3	77 227	77 227	-	-	-	-	78 477
17	**Intermediate consumption of domestic output excl. VAT**	12 939	9 374	3 545	-	20	2 034 625	2 028 888	1 230	2 088	21	2 398	2 047 564
18	Intermediate consumption of imports excl. VAT	748	479	268	-	1	341 431	340 456	225	328	4	417	342 179
19	Non-deductible VAT	987	632	353	-	2	27 253	27 192	54	7	-	-	28 240
20	**Intermediate consumption total incl. VAT**	14 674	10 485	4 166	-	23	2 403 309	2 396 536	1 510	2 422	25	2 816	2 417 983
21	Consumption of fixed capital	6 486	1 155	5 278	35	18	301 388	296 281	401	1 331	277	3 098	307 874
22	Taxes less susidies on production	-	-	-	-	-	73 440	73 440	-	-	-	-	73 440
23	Compensation of employees	6 173	4 358	1 815	-	-	1 309 347	1 304 867	482	1 696	104	2 198	1 315 520
24	Property and entrepreneurial income	-748	59	-807	-	-	552 115	552 115	-	-	-	-	551 367
25	**Gross value added at market prices**	11 910	5 571	6 286	35	18	2 236 290	2 226 703	883	3 027	381	5 296	2 248 200
26	**Output**	26 584	16 056	10 452	35	41	4 639 599	4 623 239	2 393	5 450	406	8 111	4 666 183

Germany 1990

The proposed treatment of environmental protection activities in the SEEA differs from the proposals in the SNA. The SEEA recommends to begin by presenting the (internal) ancillary activities of environmental protection in an explicit manner without treating them as separate establishments (chapter II, par. 118 - 122). It was shown that input-output of environmental protection activities are possible even in this case without greater disadvantages (Schäefer and Stahmer 1988). In the context of extending the production boundary, the SEEA describes the externalisation of internal activities in chapter V, part C. In the SNA, it is recommended to start with externalising ancillary activities in satellite analysis and treating them as separate establishments.

The German Federal Statistical Office prepared an *Environmental Input-Output Table* for Germany, 1990, as a project funded by Eurostat (Eurostat 1966). This input-output table shows the internal ancillary as well as the external (marketed) environmental protection activities without externalising the ancillary activities. The upper part of Table 12.11 shows an aggregated version of the production activities of this table. Apart from the distinction between internal and external environmental protection services, the input-output table also shows these services in a breakdown by four measures of environmental protection (waste treatment, water protection, noise abatement and air protection).

In the lower part of Table 12.11, an example is given for externalising the internal environmental protection services. In this case, the former internal services get output values which are delivered to the branch where the services took place (16 360 Mio. DM).

According to the COPP developed as a classification of the central system of SNA, the costs of production are disaggregated among functions (purposes) without double accounting: The purposes are mutually exclusive. In satellite analysis, emphasis is given to a particular purpose. Thus, all programmes or transactions related to environmental protection, for example, may be identified and grouped into a *specific purpose classification*. Once reorganised in that way, transactions classified by purpose are no longer additive because some of them may appear simultaneously under education and health, environment and research and development, etc. Such multi-purpose expenditures especially complicate the calculation of the importance of activities related to a specific purpose compared with the activities of the whole economy (Schäfer and Stahmer 1988).

Extensions and applications

part B

eurostat

Extended input-output tables as part of satellite systems

chapter 13

13.1 Satellite analysis

Satellite systems reflect the need to expand the analytical capacity of national accounting for selected areas of social concern in a flexible manner without overburdening or disrupting the central system (SNA 1993, par. 21.4). The characteristics of satellite systems allow for:

a) The provision of additional information on particular social concerns of a functional or cross-sector nature,

b) The use of complementary or alternative concepts,

c) Extended coverage of costs and benefits of human activities,

d) Further analysis of data by means of relevant indicators and aggregates,

e) Linkage of physical data sources and analysis to the monetary accounting systems.

On the one hand, satellite systems are linked with the central framework of national accounts and therefore to the main body of integrated economic statistics. On the other hand, as they are more specific to a given field or topic, they are also linked to the information system specific to this field or topic. Because they preserve close connections with the central accounts, they facilitate analyses of specific fields in the context of macro-economic accounts and analysis (SNA 1993, par. 21.5).

Satellite systems combine an extension of the kind of activity and product analysis and a generalisation of the purpose accounts. Satellite systems can be established for many fields of functional analysis, such as culture, education, health, social protection, tourism, environmental protection, research and development (Braibant 1994, Schäfer and Stahmer 1990). Most of the fields just mentioned refer to services; they are generally spread over a number of activities and allow cross-sector analysis (SNA 1993, par. 21.51 and 21.52).

Chapter XXI of the SNA gives detailed information on the concepts of satellite systems. The SNA suggests that the analysis of supply and use of specific goods and services may be inserted in an input-output framework (SNA 1993, par. 21.101). Characteristic producers, characteristic products and connected goods and services which are related to the specific subject of the satellite system, are detailed, while classifications of other producers and products are compacted. Table 21.5 of the SNA 1993 gives an example how the supply and use tables of the input-output framework can be extended.

The ESA 1995 briefly describes the concepts of satellite systems in chapter 1 (General features, paragraphs 1.18 to 1.23). This presentation is restricted to some general remarks without giving advice on the specific design of the accounting framework of satellite analysis. More information is given in documents referring to a specific field, e.g. in the European System for the Collection of Economic Information on the Environment (SERIEE) with regard to environmental protection (Eurostat 1994).

The following provides an example for using extended input-output tables in the context of satellite systems. The example refers to the comprehensive data requirements for analysing *sustainable development*.

The discussion on sustainable development has focussed on three dimensions of the problem: A successful strategy has to integrate social, environmental as well as economic aspects of sustainability. Such an approach can be symbolised by a triangle with the three dimensions of sustainability as corners (Stahmer 2000). The meeting point of economists, environmentalists and social scientists has to be found in a process of stepwise bargaining and compromise in the central area of this triangle. Each specialist has to leave his corner to consider other opinions and to find a common strategy for achieving sustainability.

Input-output tables can play an important role in delivering a suitable database for studying sustainable development. Experiences during the last years have shown that it is best to use input-output tables with differing units of presentation to facilitate special studies on different aspects of sustainability:

- Input-output tables in monetary units are especially useful for analysing economic problems,
- Input-output tables in physical units (tonnes etc.) could be used for ecological studies,
- Input-output tables in time units might serve as a data base for social studies.

A comprehensive analysis of sustainability requires an integrated analysis of all three types of input-output tables. In the following, a detailed description of the assets and drawbacks of these three types of units for presenting input-output data will be developed. As an example, comparable input-output tables using the above mentioned different types of units are shown describing the German economy in the year 1990.

13.2 General conceptual considerations on extending input-output

13.2.1 Beyond the narrow concept of production

Two concepts of the production boundary of an economy are distinguished in the System of National Accounts (SNA 1993): the traditional approach which mainly includes production for other economic units and a broader concept, also taking into account that part of household production which can be done by third parties. This concept is explained in SNA 1993, par. 6.14 - 6.36, but also in a later publication of the United Nations (United Nations 2000a).

These concepts seem to be too narrow for analysing social, economic and environmental problems in a comprehensive way. For describing the social dimension of sustainability, all activities of the population have to be considered. On the average of the whole population including all ages from babies up to retired persons, employment activities comprise only two of the twenty-four hours per day, whereas all other activities are normally neglected in traditional economic analysis.

It was shown in the sixties that a useful general activity analysis can be introduced which interprets all household activities as the production of services (Becker 1964, Lancaster 1966 and Lancaster 1971). Such a concept is useful for social as well as for environmental studies. Households not only produce “goods” in form of goods and services but also “bads”, such as wastes and air pollutants.

According to such a comprehensive activity concept, the production boundary as well as the corresponding concept of capital have to be extended. All purchases of consumer durables become part of capital formation, and the depreciation of these goods is part of household costs.

13.2.2 Beyond the economic concept of transactions

In national accounting, the description of transactions focuses on transactions which are actually carried out in monetary units. In special cases such as barter transactions, non-monetary transactions are valued using comparable market values (SNA 1993, par. 3.34 - 3.49).

This approach cannot be sufficient if a comprehensive activity analysis is planned. The physical flows of materials from nature to the economy have to be described, as well as all transformation processes within the economy and the material flows back to nature. In the traditional framework, only a fraction of the material flows are valued in monetary units, while all other transactions are neglected.

Furthermore, all service flows within the household sector are not taken into account. The following paragraphs will discuss the possibility of extending this narrow economic concept of transactions, to achieve a comprehensive database for sustainability studies.

13.2.3 Limits of monetary valuation

In the nineteen sixties and seventies, many economists hoped to describe economic activities in a comprehensive way using the concept of economic welfare (Nordhaus and Tobin 1972, NNW Measurement Committee 1973, Uno 1995, Diefenbacher 1995, Reich and Stahmer 1993). The measure of economic welfare includes not only the traditional economic transactions, but also a comprehensive valuation of all household activities, as well as of the environmental costs of economic activities.

Further stimulation for comprehensive valuation was given in the nineteen eighties by the discussions on environmentally adjusted gross domestic product. The aim of these approaches was to calculate a sustainable level of economic activity.

Different versions of this measure were presented in the System for Integrating Environmental and Economic Accounting (SEEA) of the United Nations (United Nations 1993, van Dieren 1995). The concepts discussed revealed fundamental differences in comparison to the welfare measures presented in the seventies. The aim of economic activities cannot only be defined as the maximisation of present welfare of the own population but rather as a path of development which takes into account the welfare in other countries and the needs of future generations too. It was *A Long Goodbye* (Raymond Chandler) to the dream of an overall welfare measurement (Radermacher and Stahmer 1996).

The debate on possibilities of calculating a sustainable level of economic activities has also shown that an approach dealing with sustainability in a national accounting framework has severe drawbacks. Sustainability paths could often only be reached after a longer period of adjusting economic processes. Thus, modelling of future scenarios seems to be unavoidable, which cannot be adequately reflected in the backward-oriented national accounting system. Furthermore, the international interrelationships, especially the global impacts of economic activities and the indirect environmental impacts of imported goods and services abroad, have to be taken into account (Ewerhart and Stahmer 1998).

Considering this discussion, national accountants may arrive at a more modest approach of additional monetary quantification. In any case, it seems to be useful to value those non-monetary flows which might have similarities to market transactions and, thus, could be quantified in monetary terms by using comparable market values. Examples of such imputations are estimates at market values for the flows of natural resources from nature to the economy, and for the services provided by households as far as they could also be delivered by third persons. This concept is described as version V.1 in the SEEA (United Nations 1993, Stahmer 1995).

Of course, such a limited concept of imputed monetary values cannot be sufficient for an extensive description of the social, environmental and economic dimensions of human activities. Household activities not following the third-person criterion, as well as the impacts of economic activities on the natural environment (like climatic changes), cannot adequately be analyzed. The third-person criterion states that an activity is said to be productive or to fall within the “general production boundary” if its performance can be delegated to a third person and yields the same desired results. In the following paragraphs, some other types of input-output tables which can play a complementary role are discussed.

13.2.4 Uses of physical accounting

A complete description of the interactions between nature and human beings can only be done by using physical units, such as tonnes, joules, etc. Such physical accounting can show the material flows from nature to the economy, the different steps of transformation within the economy and, finally, the material flows back to nature. Physical accounting also allows consistent balancing of all metabolic processes of living beings, such as plants, animals and human beings. A concept for treating human beings as an integral part of nature seems to be urgently needed (Ayres and Simonis 1994; Strassert 1998; de Boer, van Dalen and Konijn 1996.

These considerations have already led to physical accounting as an integral part of the SEEA (United Nations 1993). Similar concepts have been used to compile physical input-output tables in Germany, Denmark and Italy (Stahmer, Kuhn and Braun 1998; Gravgard Pedersen 1998; Nebbia 1999; de Boer, van Dalen and Konijn 1996). In the case of the German physical input-output tables, units of weight (tonnes) have been used supplemented by a description of energy flows in thermal values (joule).

The physical input-output tables also show physical changes connected with household activities. Of course, these physical processes are mainly transformations of goods into residuals which are stored, treated or disposed of into nature.

The difficulty of taking into account qualitative aspects of material flows is a severe disadvantage of physical accounting. Poisonous and innocuous materials are ‘valued’ only by their weights, but not according to their impacts, e.g. on living beings. Such an analysis has to be made in a second step, using suitable weighting schemes. Nevertheless, consistent material balances of all metabolic processes in units of weight are indispensable as a database for all further studies of the physical world.

Another shortcoming of physical accounting is the insufficient description of the production of services. These activities have an increasing importance in all countries. Hence, additional information on services has to be delivered by input-output tables in other units, e.g. in monetary units or units of time.

13.2.5 Uses of time accounting

It is an old dream of economic science to describe economic activities by using non-monetary units. It has been discussed repeatedly whether it is possible to break through the appearance of revealed monetary values and to discover the hidden mystery of the substance of economic production (Reich 1981, Reich 1989).

In classical economic science, such analysis was carried out by using the necessary labour time for producing goods and services as indicator of their true values (Fleissner 1991; Fleissner, Böhme, Brautzsch, Höhne, Siassi, Stark 1993). Unfortunately, this approach again raises problems. In which way should skilled labour be weighted in comparison to simple work? Could the contribution of machines, buildings, etc., for producing goods and services be neglected?

These problems could only be solved by introducing the concept of the 'frozen' labour time used for producing education services as well as investment goods in the past. Such labour time 'melts' in the described present when skilled labour or fixed capital goods are used. Following this concept, depreciation of both education (human) capital and fixed assets can be calculated in time units (compare Austrian capital theory in Böhm-Bawerk 1889/1891, Faber and Proops 1990). In this case, the time of skilled labour is composed of both the actual working hours and the depreciation of the accumulated hours of educational services necessary to achieve the respective level of labour (Schultz 1961, Schultz 1962, Becker 1964, Bos 1996, Keuning and de Ruijter 1988, OECD 1998).

The transformation of monetary values into time values has to take into account not only direct inputs of working time, but also the labour inputs on preceding stages of production. Such analysis can only be done by using input-output models (Stäglin and Pischner 1976, Flaschel 1980). The time directly and indirectly necessary to produce goods and services can be calculated in the following way (Stahmer and Ewerhart 1999; Stahmer, Kuhn and Braun 1998):

(1) $p = s(I - A - D)^{-1}$

where:

p = Vector of total labour 'cost' of production

s = Vecor of coefficients of direct labour inputs related to gross output

A = Matrix of coefficients of intermediate inputs including imported intermediate products (related to gross output)

D = Matrix of coefficients of depreciation by investment good and branch related to gross output

The Leontief-inverse coefficients in formula (1) also include the coefficients of depreciation D. This extension of the normally used inverse coefficients allows endogenisating the use of capital goods including the depreciation of human capital. Thus, the time values of products comprise both current and capital costs (for an extensive introduction to input-output analysis, see: Miller and Blair 1985).

As already discussed in Section 13.2.1, a suitable concept of economic activities would comprise all human activities (Pyatt 1990, Aulin-Ahmavaara 1991, Kazemier and Exel 1992, Fontela 1994, Stahmer 1995, Franz 1998, Becker 1965, Lancaster 1966, Bródy 1970). According to this approach, the inputs of time contain not only the labour hours of occupied persons but also the 24-hour day of the whole population. Such comprehensive description of all activities in an input-output framework has been completed for Germany in spring 1999 (Stahmer and Ewerhart 1999; Aslaksen, Fagerli and Gravningsmyhr 1995). For facilitating comparisons with the physical input-output table 1990, the same reporting year has been chosen. The time input-output table is especially based on the results of a time budget study which was conducted for the years 1991/92 (Blanke, Ehling and Schwarz 1996; Franz 1998; Schäfer and Schwarz 1994). Special emphasis was laid on a detailed description of teaching and studying activities, which both improve the educational level of the population (Ewerhart 2001).

The values of products according to an input-output table in units of time cannot reflect an ideal concept of true values even if the depreciation of human capital and produced fixed assets are taken into account. It seems to be impossible to include all important factors of production. As an example, the infrastructure of organisation and knowledge documented in books and other media cannot be adequately represented in units of time. The present situation is determined by activities which reach back to the preceding decades and even centuries. It seems impossible to transform this influence into data on time use. Furthermore, all environmental problems connected with human activities are neglected in a time input-output table.

Nevertheless, the comprehensive valuation of human activities in units of time has huge advantages. While physical input-output tables can give a complete description of all interrelationships between human activities and their natural environment, the time input-output tables can present a complete picture of all human activities. Furthermore, it allows linkage to quantitative as well as qualitative data on the whole population. Such linked analysis of economic, environmental and demographic aspects of society has been widely neglected in the past.

This brief presentation of the advantages and drawbacks of the three types of units within an input-output framework has shown the necessity of combining their advantages for achieving a comprehensive description of human activities. The old debate on suitable units of presenting economic activities might be closed by admitting that no approach can be regarded as loser or winner. Instead of fighting against each other, cooperation seems to have a higher priority.

The next part will discuss similarities and differences between the three types of input-output tables for describing primary and intermediate inputs, gross output and final uses of the economy in the different quadrants of the tables. For the numerical example 1990 data of Germany has been used. The extended versions are based on the German input-output table 1990[6] published in 1994 (Statistisches Bundesamt 1994).

13.3 Comparison of the concepts of three types of extended input-output tables

For describing the three types of tables, it is first necessary to discuss the concepts used in their preparation.

13.3.1 Classification of activities

A common activity classification has been used for facilitating a comparison between the three types of input-output tables. This classification comprises the breakdown of activities by 58 branches and 30 additional branches normally applied in input-output tables. The activities shown in addition are two branches of environmental protection services (waste water treatment, waste disposal), ten branches of education services (from the level of kindergarten up to university level) and eighteen branches of household services containing ten activities related to studying (corresponding with the ten branches of education services).

In the national 1990 classification, the environmental protection services and the education services were not separated, but included in the respective branches of enterprises, non-profit institutions serving households and government. The classification used in this chapter is already similar to NACE rev. 1 (see code no. 80: Education services, code no. 90: Sewage and refuse disposal services, sanitation and similar services). The activities of environmental protection and education have been separated from their institutional background and shown in branches comprising all activities of the same kind.

The branches of household services are additional branches. In the traditional context, purchases of households are only shown as part of private consumption. It should be stressed that all activities are included comprising the household production activities (following the third-person criterion) as well as other activities, such as services related to employment (e.g. driving to the work place), study activities, activities of media consumption, social contacts and physiological regeneration.

The input-output tables presented in Section 13.4 of this manual are aggregated to 12 branches: agriculture, forestry, fishing; mining, water and energy supply; manufacturing; construction; market services (except marketed environmental protection and education services); environmental protection services; education services; non-market services (except non-marketed environmental protection and education services); household production services; household services related to employment; household services related to studying; other household services.

13.3.2 Primary inputs

Table 13.1 gives an overview of the different types of primary inputs presented in monetary, physical and time input-output tables. In the case of monetary input-output tables, the traditional one is shown in addition to the extended version.

[6] Germany (excluding ex GDR)

Table 13.1: Primary inputs in monetary, physical and time input-output tables

Ser. No.	Description	Monetary IOT traditional	Monetary IOT extended	Physical IOT	Time IOT
		million DM	million DM	1 000 tons	million hours
		(1)	(2)	(3)	(4)
1	**1. Labour inputs**	**1 868 800**	**2 584 225**		**554 096**
2	employment	1 868 800	1 866 887		46 268
3	margin of labour and education		- 135 814		
4	household activities		853 152		507 828
5	household production		853 152		82 312
6	activities related to employment				12 255
7	activities related to education				15 430
8	other household activities				397 831
9	**2. Revenues on products**	**101 680**	**179 391**		
10	non-deductible value added tax	28 240	105 951		
11	taxes less subsidies on products	73 440	73 440		
12	**3. Consumption of fixed produced capital**	**303 010**	**572 542**	**42 216**	**36 012**
13	fixed assets (except consumer durables)	303 010	307 874	38 106	9 451
14	consumer durables		126 030	4 110	3 907
15	education (human) capital		138 638		22 654
16	**4. Withdrawal from the non-produced natural capital**			**49 510 759**	
17	water			46 427 665	
18	other raw material			3 083 094	
19	oxygen			810 171	
20	carbon dioxide, other air emissions			311 838	
21	soil excavation			1 151 818	
22	energy carriers			193 347	
23	other solid materials			615 920	
24	**5. Imports from the rest of the world**	**342 179**	**502 842**	**387 100**	**16 741**
25	goods (without private consumption goods)	301 892	301 892	342 904	9 441
26	services (without private consumption services)	40 287	40 287	46	1 268
27	private consumption goods and services		160 662	44 150	6 032
28	**Total primary inputs**	**2 615 669**	**3 839 000**	**49 940 075**	**606 849**

Germany 1990

Primary inputs represent a fresh impetus given to economic circulation. In this sense, primary inputs are treated as external factors whereas intermediate inputs already contain primary inputs of preceding production stages. Thus, they are shown as endogenous part of the economic circulation. In the input-output tables, primary inputs are presented in the third quadrant of the table, whereas intermediate inputs are items of the first quadrant.

In the traditional monetary input-output tables (Table 13.1, column 1), three types of primary inputs play prominent roles:

- the production factor of labour measured with its income flows,
- the production factor of fixed capital measured with its depreciation, and
- the flow of imports of goods and services used for domestic production.

In addition, the government revenues on products (like non-deductible value added tax and production taxes) are treated as primary inputs.

In the extended monetary input-output tables (Table 13.1, column 2) the same types of primary inputs are used, but the contents of the different items are substantially extended. In the case of labour inputs, imputed values of time spent on household production, according to the third-person criterion, are included. Furthermore, a margin of labour and education is included which balances the depreciation of education (human) capital, as well as additional intermediate inputs regarding household services related to employment. It is assumed that labour income includes components corresponding to the depreciation of education capital, recorded as part of the consumption of fixed produced assets and with the additional costs of households related to employment. To avoid double counting, the income flow has to be corrected by using the mentioned margin.

The extension of the production boundary also influences the other primary inputs of the extended monetary input-output table. Purchases of private consumption products are now treated as intermediate inputs. This concept implies that the non-deductible value-added tax on private consumption products, as well as the imported part of private consumption, are now treated as primary inputs and therefore increase the respective items.

The purchase of consumer durables is part of capital formation in the extended monetary input-output tables. According to this concept, depreciation of consumer durables is treated as a primary input.

Monetary data on economic uses of the natural environment are still missing in the extended monetary input-output table of 1990.

Market valuation of the raw materials extracted from nature could be used as a starting point for such estimation. Estimates of the use of nature as a sink for economic residuals are much more difficult to obtain, because the impacts of present activities are normally only observable in the future. Furthermore, such impacts could be international, even global.

Primary inputs of physical input-output tables (see Table 13.1 column 3) can only comprise data which could be measured in physical terms. Such information is especially available in the case of raw materials which are withdrawn from nature. These materials include water flows, air components, such as oxygen (inputs of animals) or carbon dioxide (inputs of plants), as well as solid materials, such as sub-soil assets. Other physical flows recorded as primary inputs are imported goods from the rest of the world which are used as intermediate inputs.

In physical input-output tables, a presentation of the uses of fixed assets creates difficulties. The concept of net capital stock and depreciation cannot be applied, because decreasing monetary values do not necessarily correspond with decreasing physical stocks. Hence, the so-called gross concept of fixed assets (see ESA 1995 par. 9.27) is preferable. According to this concept, fixed assets are recorded in two different periods: in the reporting period of investment and in the period when the respective asset retires from the production process. In this period, a physical flow is shown from final uses back to the branch which had used the asset. Such a flow is treated as a primary input, substituting for the depreciation value of the monetary tables. It increases gross output and is distributed according to the destination of the asset (e.g. being re-used, being treated as waste, or being discharged on controlled landfills).

Such a concept cannot be considered an ideal approach (Strassert and Stahmer 2002). It might be preferable to treat fixed assets at the beginning of the respective period as intermediate inputs of production processes, and assets at the end of the period as additional output of production (von Neumann 1945, Lancaster 1971). Such a procedure would allow an endogenous treatment of assets in activity analysis and would also facilitate a description of physical flows connected with fixed assets. Further discussion is necessary to clarify the concepts which should be targeted.

A comprehensive description of human activities as a primary factor of production can only be given by using an input-output table based on time as the unit of presentation. According to the concepts of time input-output tables (see Table 13.1, column 4), primary inputs of labour are not limited to the working hours of employed persons, or to the time spent for household production (following the third-person criterion), but comprise the complete time budget of the whole population.

The labour inputs of time (1990: 554.1 billion hours) representing the entire time spent by the population can only reflect quantitative, but not qualitative, aspects of labour. This disadvantage of time accounting can be reduced by introducing a concept of education (human) capital and calculating the depreciation of such capital stock in time units. Such an estimate could be based on information about the accumulated use of time spent for teaching and studying. In a second step, the education capital can be depreciated according to the length of life time persons use the knowledge accumulated.

A similar procedure has been used to calculate the direct and indirect time inputs which were necessary to produce fixed produced assets (e.g. machinery, equipment, buildings and consumer durables) used for production purposes. The monetary depreciation of fixed assets could be completely transformed into time units. Furthermore, the imported intermediate inputs were calculated in direct and indirect labour inputs, by assuming that the structures of production (input coefficients related to outputs) are the same for both domestic production and production in foreign countries.

The concept of time used in these input-output tables cannot be sufficient in the field of environmental studies; raw materials withdrawn from nature are normally not produced by human beings. Therefore, they cannot be transformed into production time of human activities. Supplementary data in physical units are necessary to give a more comprehensive picture of the economic-environmental interrelationships.

13.3.3 Intermediate inputs

The intermediate inputs of economic activities in the different types of input-output tables are presented in **Table 13.2**, rows 1 to 11. The intermediate inputs shown in the first quadrant comprise only domestic goods and services used in production processes. Imported intermediate products are treated as primary inputs and recorded in the third quadrant of the input-output tables (see Section 13.3.2).

The extended monetary input-output table (Table 13.2, column 2) differs from the traditional version (Table 13.2, column 1) with regard to the treatment of environmental protection services and household activities. Environmental protection services for housing (e.g. payments of households for waste water and waste treatment) are not recorded as intermediate inputs of the housing sector (as a part of the rent), but as direct inputs of household activities. The purchases of household consumption goods and services are (except for consumer durables) intermediate inputs of household activities. An additional increase of intermediate inputs of household activities is caused by internal flows of household services which are used as intermediate inputs of other household activities.

In physical input-output tables (Table 13.2, column 3), intermediate inputs consist of domestic products and of residuals of domestic production which are recycled or treated in environmental protection facilities. Intermediate flows of services are not recorded in the physical table (exceptions are, for example, some equipment for defence purposes or meals prepared in restaurants).

In time input-output tables, the product flows of the extended monetary input-output tables are transformed into the hours directly and indirectly necessary to produce the respective products. In contrast to the physical version, both goods and service flows can be valued in time units (see Table 13.2, column 4).

13.3.4 Outputs

The outputs of the different activities (see Table 13.2, rows 13 to 30) are identical with the totals of intermediate and primary inputs.

In traditional monetary input-output tables (Table 13.2, column 1), outputs consist of products sold, increases of stocks of own products and products used in the same unit for own purposes (e.g. own-account production of assets). In the case of non-market production, market values of the products are not available. Consequently, gross outputs are calculated as totals of intermediate and primary inputs.

In the extended monetary input-output tables (Table 13.2, column 2), additional outputs of household activities are shown. These outputs are compiled in the same way as non-market services in the traditional framework, by adding all intermediate and primary inputs of the respective activity. These inputs comprise private consumption goods, depreciation of both consumer durables and education (human) capital and, in the case of household production services (following the third-person criterion), monetary values of the time spent on these activities.

Table 13.2: Intermediate inputs and gross outputs in monetary, physical and time input-output tables

Ser. No.	Description	Monetary IOT		Physical IOT	Time IOT
		Traditional	extended		
		Million DM		1 000 tons	million hours
		(1)	(2)	(3)	(4)
	Intermediate Inputs				
1	**1. Product inputs**	**2 041 341**	**4 040 240**	**8 437 839**	**203 487**
2	goods (except water and private consumption goods)	1 031 867	1 031 867	1 565 100	33 915
3	Water	8 953	8 953	6 654 051	220
4	services (incl. re-used products, without private consumption services)	1 000 521	992 090	73 872	40 166
5	private consumption goods and services (except water)		879 173	109 279	27 262
6	services related to employment		58 372		14 685
7	intermediate uses of household production services		1 069 784	35 537	87 239
8	**2. Residual inputs**			**4 536 634**	
9	wastes for economic re-use and treatment			140 468	
10	waste water for treatment			4 396 166	
11	**Total intermediate inputs**	**2 041 341**	**4 040 240**	**12 974 473**	**203 487**
	+ Primary inputs				
12	**Total primary inputs**	**2 615 669**	**3 839 000**	**49 940 075**	**606 849**
	= Gross outputs				
13	**1. Product outputs**	**4 657 010**	**7 879 240**	**9 266 130**	**810 336**
14	goods (except water)	2 380 859	2 380 859	2 452 146	77 769
15	water	8 972	8 972	6 661 841	220
16	services (incl. re-used products, except household services)	2 267 179	2 261 702	116 606	83 011
17	household services		3 227 707	35 537	649 336
18	Household production services		1 351 755	35 537	111 302
19	Services related to employment		58 372		14 685
20	Services related to education		42 215		18 255
21	other household services		1 775 365		505 094
22	**2. Residual outputs**			**53 648 418**	
23	waste water			49 246 503	
24	water vaporized			1 566 597	
25	other residuals			2 835 318	
26	Oxygen			226 052	
27	carbon dioxide, other air emissions			811 944	
28	soil disposal, other solid materials			1 507 635	
29	Wastes			289 687	
30	**Total outputs**	**4 657 010**	**7 879 240**	**62 914 548**	**810 336**

Germany 1990

In physical input-output tables (Table 13.2, column 3), outputs consist of products and residuals of production processes. The outputs of service activities (also including all household activities) normally comprise only residuals. Thus, the importance of the service sector for the whole economy cannot be adequately reflected in a physical framework.

In time input-output tables (Table 13.2, column 4), outputs are valued by the hours directly or indirectly being necessary to produce the respective goods and services. Such a concept also allows an adequate treatment of all household activities; labour inputs of these activities are valued by the hours spent. As far as imported products are used for domestic production, the time values of these products are calculated by using the assumption that the production processes of both domestic production and production abroad have the same input structures. Furthermore, it has already been mentioned that the depreciation of fixed assets, including consumer durables and education capital, is calculated by the time necessary to produce the respective investment goods and services in the reporting period.

13.3.5 Final uses

Final uses are outputs of economic activities which leave the economic cycle. They are described in the second quadrant of input-output tables. An overview of the final uses presented in the different types of tables is given in Table 13.3.

Table 13.3: Final uses in monetary, physical and time input-output tables

Ser. No.	Description	Monetary IOT		Physical IOT	Time IOT
		Traditional	extended		
		Million DM		1 000 tons	million hours
		(1)	(2)	(3)	(4)
1	**1. Private consumption**	**1 085 325**	**2 076 030**		**529 997**
2	consumption products	940 548	2 057 337		529 157
3	Goods	306 052			
4	Services	634 496			
5	household services		2 057 337		529 157
6	consumer durables	114 047			
7	consumption of non-profit institutions serving households	30 730	18 693		840
8	**2. Government consumption**	**444 070**	**361 944**		**13 761**
9	except education services	358 994	361 944		13 761
10	education services	85 076			
11	**3. Fixed capital formation**	**425 577**	**685 408**	**733 007**	**40 041**
12	produced natural assets			28 699	
13	machinery and equipment	176 928	176 928	8 554	5 605
14	buildings	248 248	248 248	553 052	8 339
15	consumer durables		114 047	4 403	4 040
16	education (human) capital		145 784	20 949	22 006
17	change in stocks	401	401	117 350	51
18	controlled landfills				
19	**4. Disposal into the non-produced natural capital**			**48 994 384**	
20	waste water			44 846 589	
21	water vaporized			1 565 925	
22	other residuals			2 581 870	
23	Oxygen			226 052	
24	carbon dioxide, other air emissions			811 655	
25	soil disposal, other solid materials			1 507 577	
26	Wastes			36 586	
27	**5. Exports to the rest of the world**	**660 697**	**715 618**	**212 684**	**23 051**
28	Goods	577 696	602 226	192 591	19 119
29	Services	83 001	113 392	17 950	3 932
30	wastes for treatment			2 143	
31	**Total final uses**	**2 615 669**	**3 839 000**	**49 940 075**	**606 850**

Germany 1990

In the traditional monetary input-output tables (Table 13.3, column 1), four types of final uses are distinguished:

- private consumption,
- government consumption,
- fixed capital formation (including change in stocks), and
- exports of goods and services.

Private consumption comprises purchases of private consumption products and the consumption of non-profit institutions serving households. The products purchased disappear into a 'black hole', because their further uses in household activities are not described. Furthermore, it is assumed that consumer durables are consumed in one period. This concept reveals the low priority household activities are given in traditional national accounting.

Government consumption consists of all government services which are provided for the whole community, without payment of specific users.

Fixed capital formation contains only investment goods which are used for production purposes. Thus, consumer durables are not taken into account because household activities are not treated as production in the conventional framework. Furthermore, changes of non-produced natural capital are not recorded.

The flows between the home country and the rest of the world only record goods and services. Flows of residuals (e.g. air emissions) which might affect the natural environment of other countries are not taken into account.

Substantial changes between the results of the traditional input-output table and the results of the extended input-output table can be observed in the extended version of monetary input-output tables (Table 13.3, column 2).

Private consumption is now defined as the final use of household services produced in the different branches of household activities. The aggregates could be interpreted as consumption for own use, similar to government consumption. Corresponding with government consumption and consumption of non-profit institutions serving private households, private consumption is valued by the costs of household activities (intermediate consumption, depreciation, value of time spent for household activities).

Unfortunately, the concept of government consumption has not been substantially modified. So far, the treatment of education services as investment is the only conceptual change.

The concept of fixed capital formation shows more important changes in the extended monetary input-output tables. Apart from the treatment of consumer durables as investment goods, the education services and the household services related to studying are treated as fixed capital formation which increases the education (human) capital. The household services related to studying comprise all costs of pupils and students directly associated with their studies (e.g. travelling costs, costs of teaching aids, part of housing costs). Further changes of fixed capital formation would be necessary if changes of natural capital were taken into account.

The final uses of physical input-output tables (Table 13.3, column 3) do not comprise private and government consumption, because all physical inputs of government and private activities are treated as intermediate inputs. The outputs of these activities are services without material counterpart, as well as residuals which partly increase the flows back into nature. Fixed capital formation and disposal into non-produced natural capital are the most important aggregates of final uses in the physical input-output tables. As far as exports comprise physical goods, they are shown as physical flows to the rest of the world.

The concept of final uses in the time input-output tables (Table 13.3, column 4) is very similar to that of the extended monetary input-output tables. The value of private consumption, also including most of the time spent for household activities, dominates all other aggregates. In the context of fixed capital formation, the increase of education (human) capital also contains the time pupils and students spend studying.

13.4 Description of the three types of input-output tables

We now move to the three types of tables discussed above, and offer a description of each in turn.

13.4.1 General comments

In the following paragraphs, the three types of input-output tables showing German economic activities in the year 1990 are briefly described (see **Tables 13.4 to 13.6**). Comments will focus on the twelve activities which are presented in the highly aggregated tables. It has already been mentioned that the input-output tables have been compiled from 91 activities (see Section 13.3.1). The tables will be published in this detailed classification to allow special studies, e.g. on household activities or on education services (Stahmer, Ewerhart, Herrchen 2002).

It is not possible to describe all supplementary tables which have been compiled in the context of the three extended input-output tables. It should be mentioned that import matrices are available for all types of input-output tables, showing the imports in a breakdown by product group as well as by using branch and final use, respectively (see Table 13.8). In Tables 13.4 to 13.6, the column totals of the import matrices are only presented as primary inputs of the respective using branches.

Several additional tables are available in the case of physical input-output tables. The data comprise detailed information on the material inputs and outputs of economic activities, which can be further subdivided into complete material balances of energy uses, water uses and other materials. Furthermore, special balances of biological metabolism of animal plants and human beings are estimated.

In the case of physical input-output tables, it might be useful to reduce material flows for some specific analyses. There are throughput materials which do not enter economic circulation, but are only treated as primary inputs (withdrawal from non-produced natural assets) and final uses (disposal into the non-produced natural assets). Most important examples are water flows, like cooling water, which enter the natural sphere again without any further treatment. Other examples are soil materials only moved in the context of construction activities. In Table 13.5, throughput materials are shown in row 20. They comprise about three quarters of all material flows without having an important economic or ecological influence. Thus, it could be considered to remove them before analysing the physical flows of economic activities in the context of physical input-output tables.

In the case of time input-output tables, additional information on the qualification structures of employed persons by branch are available. Furthermore, data on the qualification levels of the whole population can be combined with the complete range of household activities.

13.4.2 Extended monetary input-output table

The activities shown in columns 1 to 5 and 8 of Table 13.4 represent the traditional classification of production activities. Special emphasis is given to environmental protection activities which are explicitly presented in column 6 and row 6.

The environmental protection activities only include services which are delivered to third parties (external protection activities) whereas internal protection activities, like water treatment plants for own purposes, are not taken into account (Schäfer and Stahmer 1988, Eurostat 1994)[7]. It might be possible to 'externalise' their costs by establishing separate production units (see Table 12.11 of Chapter 12), but it would be very difficult to estimate the corresponding physical flows, e.g. of waste and air pollution.

In column 7 and row 7, there is a description of education services of government institutions, enterprises and non-profit institutions serving households. The gross output of these activities is treated as fixed capital formation and increases the stock of education (human) capital (row 7, column 18). The consumption of education capital is associated with those activities which use the accumulated knowledge of people (row 19). As far as labour inputs have monetary values (row 14), it is assumed that the value of depreciation of education capital is part of these revenues. To avoid double counting, a (negative) margin of labour and education has been introduced (row 15) which also counterbalances the intermediate inputs of household services related to employment (row 10).

[7] See section 13.2.3 of Chapter 12.

It is assumed that all household activities are productive. Nevertheless, the use of the term 'household production' is limited to the case of household activities which meet the third-person criterion (column 9 and row 9). The gross output of household production is compiled as the total of the value of intermediate consumption products, depreciation of consumer durables and the value of the time spent for household production. The depreciation of education capital is counterbalanced by the mentioned margin (row 15, column 9).

Table 13.4: Extended monetary input-output table

Billions of Deutsche Marks

Row No.	Uses / Supply	Input of branches										
		agriculture, forestry, fishing	mining, water and energy supply	manufacturing	construction	market services	environmental protection services	education services	non-market services	household production	services related to employment	services related to studying
		1	2	3	4	5	6	7	8	9	10	11
	Product output by product group											
1	Prod. of agric., forestry, fishing	8		43		6	-		1	6		
2	Prod. of mining, water, energy supply	2	31	45	1	21	1	2	6	15		
3	Products of manufacturing	15	13	571	72	109	2	3	41	109	8	2
4	Construction work	1	4	7	4	23	2	1	7	1		-
5	Market services	8	16	289	40	425	2	8	109	128	20	10
6	Environmental protection services		1	5	2	2	5	1	1	3		
7	Education services	-	-	-	-	-	-	-	-	-	-	-
8	Non-market services		1	6	1	5	1		67	3		2
9	Household production services	-	-	-	-	-	-	-	-	130	-	17
10	Hh. serv. related to employment	1	1	18	4	23	-	3	10	-	-	-
11	Hh. serv. related to education	-	-	-	-	-	-	-	-	-	-	-
12	Other household services	-	-	-	-	-	-	-	-	-	-	-
13	Product and residual inputs, totals	34	66	984	123	613	13	17	242	395	29	32
14	Labour inputs	29	48	581	120	794	5	78	212	853	-	-
15	Margin of labour and education revenues on products	- 2	- 2	- 28	- 6	- 37		- 6	- 15	- 40	-	-
16	Non-deductible value added tax	-	-	-	-	12	1	1	14	23	3	1
17	Tax. less subsidies on products	- 5	- 3	55	2	23	-			-	-	-
18	Cons. of fixed produced assets	12	20	73	5	171	7	8	12	33	14	3
19	Education (human) capital	1	1	10	2	14		3	6	40	5	5
20	Throughput materials	x	x	x	x	x	x	x	x	x	x	x
21	Other materials	x	x	x	x	x	x	x	x	x	x	x
22	Goods	6	13	225	13	30	1	1	14	42	5	1
23	Services		1	9	1	23		1	6	5	2	1
24	Primary inputs, totals	42	79	925	138	1 029	14	87	248	957	30	11
25	Gross output, balancing items	76	145	1 908	261	1 642	27	104	490	1 352	58	42

Row No.	Uses / Supply	Input of branches		Final uses								Total
		other services	Total	private con-sump-tion	govern-ment con-sump-tion	fixed assets (except consumer durables incl. change in stocks)	con-sumer dura-bles	educa-tion capital	into the non-pro-duced natural capital	to the rest of the world	Total	
		12	13	14	15	16	17	18	19	20	21	22
	Product output by product group											
1	Prod. of agric., forestry, fishing	3	67	-	-	3	-	-	x	6	9	76
2	Prod. of mining, water, energy supply	18	141	-	-	- 1	-	-	x	4	3	145
3	Products of manufacturing	116	1 061	-	-	185	73	-	x	590	848	1 908
4	Construction work	2	53	-	-	205	-	-	x	3	208	261
5	Market services	403	1 457	-	-	33	41	-	x	112	185	1 642
6	Environmental protection services	7	27	-		-	-	-	x	-		27
7	Education services	-	-	-	-	-	-	104	x	-	104	104
8	Non-market services	21	106	19	362	1	-	-	x	2	383	490
9	Household production services	922	1 070	282	-	-	-	-	x	-	282	1 352
10	Hh. serv. related to employment	-	58	-	-	-	-	-	x	-	-	58
11	Hh. serv. related to education	-	-	-	-	-	-	42	x	-	42	42
12	Other household services	-	-	1 775	-	-	-	-	x	-	1 775	1 775
13	Product and residual inputs, totals	1 494	4 040	2 076	362	426	114	146	x	716	3 839	7 879
14	Labour inputs	-	2 720	- 2 720	-	-	-	-	x	-	- 2 720	-
15	Margin of labour and education revenues on products	-	- 136	136	-	-	-	-	x	-	136	-
16	Non-deductible value added tax	50	106	-	- 155	28	18	-	x	3	- 106	-
17	Tax. less subsidies on products	-	73	-	- 73	-	-	-	x	-	- 73	-
18	Cons. of fixed produced assets	76	434	-	-	- 308	- 126	-	x	-	- 434	-
19	Education (human) capital	51	139	-	-	-	-	- 139	x	-	- 139	-
20	Throughput materials	x	X	x	x	x	x	x	x	x	x	x
21	Other materials	x	X	x	x	x	x	x	x	x	x	x
22	Goods	70	420	-	-	66	32	-	x	- 518	- 420	-
23	Services	34	83	-	-			-	x	- 83	- 83	-
24	Primary inputs, totals	282	3 839	- 2 584	- 228	- 214	- 76	- 139	x	- 598	- 3 839	-
25	Gross output, balancing items	1 775	7 879	- 508	134	212	38	7	x	118	-	7 879

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Household production services are partly used as intermediate inputs of other household activities (row 9, columns 9, 11 and 12). The remaining values leave the economic cycle and are treated as private consumption (row 9, column 14).

Household services (except household production) (columns 10 to 12 and rows 10 to 12) represent household activities for own purposes which cannot be carried out by third persons. Thus, a suitable valuation of the time spent for these activities seems to be impossible.

The gross output of these services comprises only intermediate inputs and consumption of fixed produced assets, including the depreciation of education capital which has not to be counterbalanced in this case because no corresponding income flow is recorded. Household services related to employment (column 10 and row 10) are used by the branches employing the respective persons. Household services related to studying (column 11 and row 11) include learning activities of pupils and students. The costs of these activities are treated as investment in education capital (row 11, column 18). All other household services (column 12 and row 12) are used for consumption purposes only (row 12, column 14). These activities consist of e.g. social activities and activities for physiological regeneration (eating, sleeping etc.).

13.4.3 Physical input-output table

The physical input-output table (Table 13.5) shows a completely different picture of the economy. The activities producing material goods play a much more important role, while service branches, with their immaterial outputs, have a relatively low importance.

The production activities of agriculture, forestry and fishing (column 1 and row 1) also comprise balances of plants and animals as far as they belong to the controlled economy. Thus, an analysis of the biological metabolism of living beings is possible.

The production activities of mining, water and energy supply (column 2 and row 2) especially contain the withdrawal of raw materials from nature and their transformation into marketable goods. In comparison to the other flows of materials, water inputs and outputs dominate the description of these activities. As mentioned already, it seems to be preferable to allow a suitable reduction of these flows to facilitate the analysis of material flows. In row 20 and column 2, most of the water flows are shown as throughput materials (e.g. cooling water) which represents about a half of all material flows of the economy.

In manufacturing and construction (columns 3 and 4 and rows 3 and 4), the transformation of material goods into other material goods is described. Of course, these transformation processes require further inputs of raw materials withdrawn from nature, and they produce not only goods but also residuals. As far as soil is only moved but not used as material input of buildings etc., the respective material flow (row 20, column 4) is shown as throughput material.

In the case of market services (column/row 5), education services (column/row 7) and non-market services (column/row 8), material product inputs are normally transformed into residuals only. Apart from some exceptions (e.g. preparing meals in restaurants), the product output of services is immaterial.

Important material flows can be observed in environmental protection activities (column/row 6). Wastes and waste-water of other branches are treated and transformed into other types of residuals, which could be safely stored in controlled landfills, or which could be disposed of into nature without severe damage to ecosystems.

The material balances of household activities (columns/rows 9 to 12) are similar to those of the other service branches. Apart from preparing meals, no material product output is shown. The output of household services normally consists of residuals only. Some raw materials (e.g. oxygen and water) are taken into account in the case of the biological metabolism of human beings.

13.4.4 Time input-output table

The comments given to the extended monetary input-output table (Section 13.4.2) could be largely applied for the interpretation of the time input-output table (Table 13.6). All values of the monetary table have been transformed into time values by the labour inputs directly or indirectly necessary to produce the respective products.

Table 13.5: Physical input-output table

Millions of tons

Row No.	Uses / Supply	Input of branches										
		agriculture, forestry, fishing	mining, water and energy supply	manufacturing	construction	market services	environmental protection services	education services	non-market services	household production	services related to employment	services related to studying
		1	2	3	4	5	6	7	8	9	10	11
	Product output by product group											
1	Prod. of agric., forestry, fishing	98		80	1	1	27			9		
2	Prod. of mining, water, energy supply	65	2 085	1 344		110	111	51	311	742	67	36
3	Products of manufacturing	21	7	495	551	85	1 180	1	14	33	5	1
4	Construction work	-	-	-		29	22		6	-	-	-
5	Market services	5	-	48	21	2	112			1		
6	Environmental protection services	-		-	-	6	5	-	-	-	-	-
7	Education services	-	-	-	-		49	-	-	-	-	-
8	Non-market services	-	-	-	-	1	299	-	-	-	-	
9	Household production services	-	-	-	-	3	652	-	-	-	-	-
10	Hh. serv. related to employment	-	-	-	-		60	-	-	-	-	-
11	Hh. serv. related to education	-	-	-	-		32	-	-	-	-	-
12	Other household services	-	-	-	-	4	1 897	-	-	-	-	-
13	Product and residual inputs, totals	188	2 092	1 967	590	239	4 446	52	331	783	71	36
14	Labour inputs	x	x	x	x	x	x	x	x	x	x	x
15	Margin of labour and education revenues on products	x	x	x	x	x	x	x	x	x	x	x
16	Non-deductible value added tax	x	x	x	x	x	x	x	x	x	x	x
17	Taxes less subsidies on products	x	x	x	x	x	x	x	x	x	x	x
18	Consumption of fixed produced assets	-	2	15	21		-			1	1	
19	Education (human) capital	x	x	x	x	x	x	x	x	x	x	x
20	Throughput materials	-	31 428	5 346	113	-	3 500	-	-	-	-	-
21	Other materials	607	6 797	1 139	68	118	10	15	90	62	7	3
22	Goods	10	49	239	28	13			2	19	4	1
23	Services	-	-				-					
24	Primary inputs, totals	617	38 276	6 739	230	131	3 510	15	92	82	11	4
25	Gross output, balancing items	806	40 368	8 705	820	370	7 956	67	423	865	83	41
	Supplemantary information											
26	Product outputs	251	6 961	1 361	540	99		-	17	36	-	-
27	Residual outputs	554	33 407	7 344	280	271	7 956	67	406	830	83	41

Row No.	Uses / Supply	Input of branches: other services	Input of branches: Total	Final uses: private con-sump-tion	Final uses: govern-ment con-sump-tion	Final uses: fixed assets (except consumer durables incl. change in stocks)	Final uses: con-sumer dura-bles	Final uses: educa-tion capital	Final uses: into the non-pro-duced natural capital	Final uses: to the rest of the world	Final uses: Total	Total
		12	13	14	15	16	17	18	19	20	21	22
	Product output by product group											
1	Prod. of agric., forestry, fishing	5	221	x	x	47	-	x	527	10	584	806
2	Prod. of mining, water, energy supply	2 099	7 036	x	x		-	x	33 305.6	27	33 331.8	40 368.1
3	Products of manufacturing	35	2 425	x	x	14	4	x	6 106	156	6 281	8 705
4	Construction work	-	56	x	x	534	-	x	229		764	820
5	Market services	6	194	x	x		-	x	164	13	177	370
6	Environmental protection services	-	11	x	x	-	-	x	7 943	2	7 945	7 956
7	Education services	-	49	x	x	-	-	x	18	-	18	67
8	Non-market services		299	x	x	17	-	x	107	-	124	423
9	Household production services	36	690	x	x	-	-	x	173	2	175	865
10	Hh. serv. related to employment	-	60	x	x	-	-	x	23		23	83
11	Hh. serv. related to education	-	32	x	x	-	-	x	8		9	41
12	Other household services	-	1 901	x	x	-	-	x	508	3	511	2 411
13	Product and residual inputs, totals	2 180	12 975	x	x	611	4	x	49 112	213	49 940	62 915
14	Labour inputs	x	x	x	x	x	x	x	x	x	x	x
15	Margin of labour and education revenues on products	x	x	x	x	x	x	x	x	x	x	x
16	Non-deductible value added tax	x	x	x	x	x	x	x	x	x	x	x
17	Tax. less subsidies on products	x	x	x	x	x	x	x	x	x	x	x
18	Cons. of fixed produced assets	3	42	x	x	- 41	- 4	x	3	-	- 42	-
19	Education (human) capital	x	x	x	x	x	x	x	x	x	x	x
20	Throughput materials	-	40 387	x	x	-	-	x	- 40 387	-	- 40 387	-
21	Other materials	208	9 124	x	x	-	-	x	- 9 124	-	- 9 124	-
22	Goods	17	383	x	x	7	3	x	-	- 393	- 383	-
23	Services	4	4	x	x	-	-	x	-	- 4	- 4	-
24	Primary inputs, totals	232	49 940	x	x	- 33	- 1	x	- 49 508	- 397	- 49 940	-
25	Gross output, balancing items	2 411	62 915	x	x	578	3	x	- 396	- 185	-	62 915
	Supplemantary information											
26	Product outputs	-	9 266									
27	Residual outputs	2 411	53 648									

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Table 13.6: Time input-output table

Billions of hours

Row No.	Uses / Supply	Input of branches										
		agricul-ture, forestry, fishing	mining, water and energy supply	manu-factur-ing	con-struc-tion	market services	environ-mental protec-tion services	educa-tion services	non-market services	house-hold produc-tion	services related to employ-ment	services related to study-ing
		1	2	3	4	5	6	7	8	9	10	11
	Product output by product group											
1	Prod. of agric., forestry, fishing	0.4	0.0	2.5	0.0	0.3	-	0.0	0.1	0.4	0.0	0.0
2	Prod. of mining, water, energy supply	0.1	1.1	1.3	0.0	0.6	0.0	0.0	0.1	0.4	0.0	0.0
3	Products of manufacturing	0.5	0.4	18.0	2.2	3.4	0.1	0.1	1.3	4.2	0.2	0.0
4	Construction work	0.0	0.1	0.2	0.1	0.8	0.1	0.0	0.2	0.0	0.0	-
5	Market services	0.3	0.5	8.7	1.2	21.7	0.1	0.2	3.6	3.7	0.7	0.3
6	Environmental protection services	0.0	0.0	0.2	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0
7	Education services	-	-	-	-	-	-	-	-	-	-	-
8	Non-market services	0.0	0.0	0.3	0.0	0.2	0.1	0.0	2.9	0.1	0.0	0.1
9	Household production services	-	-	-	-	-	-	-	-	10.6	-	1.4
10	Hh. serv. related to employment	0.1	0.2	4.4	1.0	5.7	0.0	0.8	2.4	0.0	-	-
11	Hh. serv. related to education	-	-	-	-	-	-	-	-	-	-	-
12	Other household services	-	-	-	-	-	-	-	-	-	-	-
13	Product and residual inputs, totals	1.4	2.4	35.5	4.6	32.8	0.5	1.2	10.6	19.4	0.9	1.9
14	Labour inputs	2.0	0.7	13.8	3.3	17.4	0.3	1.8	6.8	82.3	12.3	15.4
15	Margin of labour and education revenues on products	x	x	x	x	x	x	x	x	x	x	x
16	Non-deductible value added tax	x	x	x	x	x	x	x	x	x	x	x
17	Taxes less subsidies on products	x	x	x	x	x	x	x	x	x	x	x
18	Consumption of fixed produced assets	0.4	0.7	2.3	0.2	5.2	0.1	0.3	0.3	1.0	0.4	0.1
19	Education (human) capital	0.2	0.1	1.5	0.4	2.1	0.0	0.4	0.9	6.7	0.9	0.8
20	Throughput materials	x	x	x	x	x	x	x	x	x	x	x
21	Other materials	x	x	x	x	x	x	x	x	x	x	x
22	Goods	0.2	0.3	7.1	0.4	0.9	0.0	0.0	0.4	1.7	0.1	0.0
23	Services	0.0	0.0	0.3	0.0	0.7	0.0	0.0	0.2	0.2	0.1	0.1
24	Primary inputs, totals	2.8	1.8	25.1	4.3	26.4	0.4	2.6	8.6	91.9	13.8	16.4
25	Gross output, balancing items	4.3	4.2	60.6	8.9	59.1	0.9	3.8	19.3	111.3	14.7	18.3

Row No.	Uses / Supply	Input of branches		Final uses								Total
		other services	Total	private con-sump-tion	govern-ment con-sump-tion	fixed assets	con-sumer durbles	educa-tion capital	into the non-pro-duced natural capital	to the rest of the world	Total	
		12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0
	Product output by product group											
1	Prod. of agric., forestry, fishing	0.2	3.8	-	-	0.1	-	-	x	0.3	0.5	4.3
2	Prod. of mining, water, energy supply	0.5	4.1	-	-	0.0	-	-	x	0.2	0.1	4.2
3	Products of manufacturing	3.4	33.7	-	-	5.9	2.4	-	x	18.6	26.8	60.6
4	Construction work	0.1	1.8	-	-	7.0	-	-	x	0.1	7.1	8.9
5	Market services	11.8	52.7	-	-	1.0	1.6	-	x	3.9	6.5	59.1
6	Environmental protection services	0.3	0.9	-	-	-	-	-	x	-	-	0.9
7	Education services	-	-	-	-	-	-	3.8	x	-	3.8	3.8
8	Non-market services	0.8	4.5	0.8	13.8	0.0	-	-	x	0.1	14.7	19.3
9	Household production services	75.3	87.2	24.1	-	-	-	-	x	-	24.1	111.3
10	Hh. serv. related to employment	-	14.7	-	-	-	-	-	x	-	-	14.7
11	Hh. serv. related to education	-	-	-	-	-	-	18.3	x	-	18.3	18.3
12	Other household services	-	-	505.1	-	-	-	-	x	-	505.1	505.1
13	Product and residual inputs, totals	92.3	203.5	530.0	13.8	14.0	4.0	22.0	x	23.1	606.9	810.3
14	Labour inputs	397.8	554.1	-554.1	-	-	-	-	x	-	-554.1	-
15	Margin of labour and education revenues on products	x	x	x	x	x	x	x	x	x	x	x
16	Non-deductible value added tax	x	x	x	x	x	x	x	x	x	x	x
17	Tax. less subsidies on products	x	x	x	x	x	x	x	x	x	x	x
18	Cons. of fixed produced assets	2.4	13.4	-	-	-9.5	-3.9	-	x	-	-13.4	-
19	Education (human) capital	8.7	22.7	-	-	-	-	-22.7	x	-	-22.7	-
20	Throughput materials	x	x	x	x	x	x	x	x	x	x	x
21	Other materials	x	x	x	x	x	x	x	x	x	x	x
22	Goods	2.4	13.6	-	-	2.1	1.0	-	x	-16.7	-13.6	-
23	Services	1.5	3.1	-	-	0.0	0.0	-	x	-3.1	-3.1	-
24	Primary inputs, totals	412.8	606.9	-554.1	-	-7.4	-2.9	-22.7	x	-19.8	-606.9	-
25	Gross output, balancing items	505.1	810.3	-24.1	13.8	6.6	1.2	-0.7	x	3.2	-	810.3

Germany 1990

The additional primary inputs of household services (except household production) (columns/rows 10 to 12) cause the only major difference between the time and the monetary input-output table. In the extended monetary tables, the direct inputs of time of these activities have not been valued. Thus, the output is compiled only as the sum of intermediate inputs and depreciation. In the time input-output table, the direct inputs of time of all household services are taken into account. These inputs amount to more than half of the value of time of all outputs of the whole economy (425 billion hours in comparison to 810 billion hours).

In the case of services related to employment (column 10 and row 10), the additional inputs of time are linked with the traditional branches of the economy. The time spent travelling to the work place is now an additional intermediate input of the branches where the commuting persons are employed. These additional inputs are not counterbalanced, but are treated as part of the gross output of the traditional branches.

According to the extended concept of inputs of time, the hours spent by pupils and students for studying are now an important part of the outputs of the household services related to studying (column/row 11). In comparison to the outputs of education services (column 7), the household activities have now a substantially increased importance as part of the investment in education capital (see column 18: 18.3 billion hours compared to 3.8 billion hours of education services).

The other household services (column/row 12) have a higher value of gross output than all other activities shown in the time input-output table (505 billion hours in comparison to 305 billion hours). This output (e.g. social and leisure activities, physiological regeneration) can be interpreted as a final objective of all activities. The outputs are treated as private consumption (row 12, column 14) amounting to five-sixths of all final use.

13.4.5 Outlook

This section has presented three different types of input-output tables, using differing units of presentation. For facilitating comparisons, the same concepts of production and capital have been applied. Furthermore, the same classifications of activities, primary inputs and final use have been used. The presentation aimed at suggesting good arguments for a combined use of these tables. Each type can only show specific aspects of economic activities, while all three types together can achieve a nearly comprehensive overview. For analysing the very general concept of sustainability, it seems to be urgently needed to describe human activities with their social, economic and ecological aspects by this magic triangle of input-output data.

Further research work is necessary to develop suitable input-output models using not only one type of table, but combining data for two or three types of input-output tables. Using monetary input-output tables and linking physical data with the results of monetary input-output analysis is a relatively simple case of linking the different types.

Furthermore, it is possible to merge parts of the three types to produce artificial new tables which might be more useful for input-output analysis. Examples of such merging procedures are energy input-output tables with both physical and monetary data (Beutel and Stahmer 1982). In more sophisticated econometric models, simultaneous use of different units of presentation could be introduced. Such models could define relationships between the elements of the different types of input-output tables (Meyer et al. 1999). Chapter 15 (Applications) of this manual gives more information on this topic.

13.5 Social Accounting Matrices (SAM) and extended input-output tables

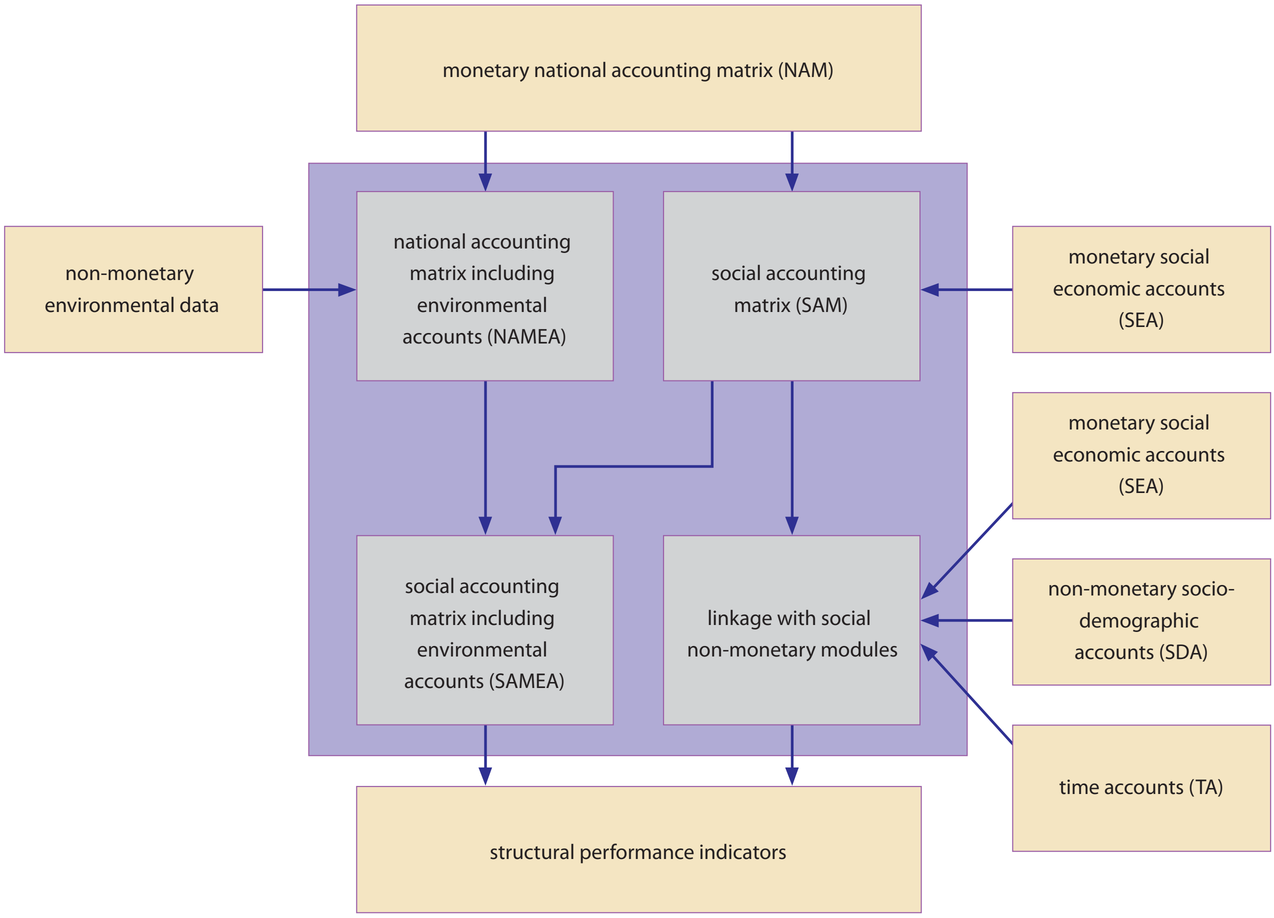
13.5.1 SAM and input-output framework

At the end of the forties and beginning of the fifties, Richard Stone already proposed a presentation of the results of national accounting not only in T-accounts but also in a matrix format (Stone 1949, Stone 1951, Stone 1952, Stone 1955a, Stone 1955b, Stone, Croft-Murray 1959, Stone 1961, Hill 1995, p. 27, Stahmer 2002). He called such matrix a *Social Accounting Matrix* (SAM) and demonstrated that input-output tables could be interpreted as a special case of a SAM: "I propose to use the term input-output table to mean a statement in current money terms of the flow of goods and non-factor services between the operating accounts of the system and between these and all other accounts combined. All other transactions in the system are aggregated and appear as the elements in the final row of the matrix" (Stone 1955b, pp. 158).

In the sixties, Richard Stone and his team developed the Cambridge Growth Model (Stone 1981a, pp. 77- 96). In this context, he also published a first SAM for Great Britain 1960 (Stone 1962b) and improved the conceptual framework of such matrix presentation. He especially stressed the importance of using different statistical units (e.g. commodities, establishments, institutional units) in the system for describing the variety of economic activities in a most suitable way. According to this concept, it is necessary to link the different parts of the accounting system by special transition matrices from one statistical unit to another (Stone 1962a). These considerations were the starting point for the concepts of the *System of National Accounts (SNA)* 1968 (United Nations 1968). The supply and disposition tables of the input-output framework became an integral part of the national accounting matrix (United Nations 1968, Stone 1979, Stone 1981b).

In the seventies, the term social accounting matrix changed its meaning. It was now used for a type of national accounting matrix especially describing the interrelationships of income and transfer flows between the different institutional units: "The pattern of these transfers conditions the distribution of income in exactly the same way as the pattern of inter-industry transactions conditions the structure of production" (Pyatt 1999, p. 366). Such special emphasis on socio-economic analysis was strongly supported by Richard Stone: "We already have a disaggregation of the productive system in input-output tables and, for a more restricted number of countries, a disaggregation of the financial system in flow-of-funds tables. The missing piece is the disaggregation of income and outlay" (Stone 1985).

Figure 13.1: System of Economic and Social Accounting Matrices and Extensions (SESAME)



In the seventies and eighties, these concepts were especially used in developing countries (Pyatt and Roe 1977, Pyatt and Round 1985). The promising experiences in these countries encouraged national accountants to propose socio-economic analysis as an integral part of the revised concepts of national accounting (Keuning, de Ruijter 1988, Keuning 1991, Pyatt 1985, Pyatt 1991a, Pyatt 1991b). This strategy was successful: SNA 1993 as well as ESA 1995 contain chapters on SAM which show its usefulness and the great variety of its applications (Commission of the European Communities et al. 1993, pp. 461-488; Eurostat 1995, pp. 195-206). In the next paragraph, the proposals of the international system of national accounts regarding the linkages between input-output and SAM are described in detail.

Great support for implementing the SAM concepts not only in developing but also in developed countries was given by the work done by Steven Keuning and his team at Statistics Netherlands. They presented the concepts and numerical examples of a *System of Economic and Social Accounting Matrices and Extensions* (SESAME) which comprises a whole family of SAM modules (See the overview in Keuning 1996, Keuning 2000 and Timmerman, van de Ven 2000 with further references). Figure 13.1 gives an overview of the different parts of the system which are able to describe economic, social and environmental aspects of human activities in an integrated framework.

13.5.2 Linkages of SAM and input-output in the ESA

In the chapter on the sequence of accounts and balancing items (Chapter 8), the ESA 1995 also describes different types of matrix presentation of national accounts data (par. 8.100 - 8.155). In the introductory remarks, it is mentioned that the input-output table is a well-known example of such a presentation: "The input-output table is a widely used matrix framework to supply detailed and coherently arranged information on the flow of goods and services and on the structure of production costs (par. 8.101)."

In the following paragraphs of ESA 1995, it is shown how the full sequence of ESA accounts and balancing items could be presented in a matrix format (8.104 - 8.125 and table 8.19). Each entry in an aggregate matrix can be considered as the grand total of a submatrix which shows detailed information by different types of actors or other groupings (par. 8.126). A more detailed matrix reveals the economic flows at a meso-level which allows an analysis of the interrelations between the different groups of economic actors. The SAM is described as a special type of matrix presentation which allows a further elaboration on the interrelations between the social and economic aspects of the system. Some information on the SAM is presented in the last part of Chapter 8 of the ESA 1995 (par. 8.133 – 8.155 and tables 8.20, 8.21).

In the introductory paragraphs of the description of the SAM, the close linkages between SAM and input-output tables are stressed:

> „*The supply and use tables opt for a classification of rows and columns which is most suitable to describe the economic processes under consideration, namely the processes of production and use of products. However, those matrices do not incorporate the interrelations between value added and final expenditure. By extending a supply and use table, or an input-output table, to show the entire circular flow of income at a meso-level, one captures an essential feature of a Social Accounting Matrix (SAM) (par. 8.133).*“

According to these considerations, the SAM is defined as a presentation of ESA-accounts in a matrix which elaborates on the linkages between a supply and use table and sector accounts (par. 8.134). Special emphasis is laid on the role of people in the economy which implies a further breakdown of the household sector and a disaggregation of the persons employed. In this context, two parts of the use table of the input-output framework are especially disaggregated: the components of net value added, shown in the third quadrant of the table, and the final uses which are presented in the second quadrant.

Table 8.22 of the ESA 1995 gives an example of a detailed matrix of net value added. The compensation of employees is subdivided by resident and non-resident employees. Resident employees are further disaggregated by sex, category of occupation and place of residence. Net operating surplus is shown in a breakdown by the (sub) sector of the enterprises to which the establishment belongs, and net mixed income according to the location of the household enterprises (par. 8.153). Employees could further be subdivided by level of schooling, age and type of job contract (full-time/part-time, permanent/temporary) (par. 8.136). Labour income should also be decomposed into hours worked and average wage rates per hour (par. 8.138).

In the input-output framework, final use is shown in a breakdown by product group. The SAM concepts recommend a further breakdown of final consumption expenditures by institutional sectors (e.g. types of households). Changes in inventories should be shown in a cross classification by product group and institutional sector, gross fixed capital formation by product group and investing industries. For socio-economic analysis, the proposed breakdown of final consumption expenditures by product group and household (sub) sectors would have higher priority than the disaggregation of capital formation.

13.5.3 Example of a SAM based on input-output analysis (SAMIO)

In this section, an example demonstrates using extended input-output tables and SAM modules to compile a SAM which is based on results of input-output analysis. This matrix is called SAMIO to stress the linkages between SAM and the input-output framework. The example should encourage common research and analysis of input-output and SAM specialists. Such cooperation is urgently needed for improving the data base for developing strategies towards sustainable development.

By applying input-output models, the SAMIO gives a very condensed picture of the production and consumption activities of certain groupings of the population. The SAM data on value added and labour inputs by socio-economic group are directly linked with the SAM modules on final uses by socio-economic groups. Such linkages of labour and consumption were already proposed by Utz-Peter Reich, Philipp Sonntag and Hans-Werner Holub some 25 years ago (Reich et al. 1977, Horz and Reich 1982, Reich 1986). They presented a "Labour-Consumption Accounting" which has several similarities with the approach presented in this section.

The SAMIO concepts allow a new type of operating surplus: Each socio-economic group not only delivers results of their production activities to themselves or to other persons but also receives such results from themselves or from others. The balancing items of these flows show for each socio-economic group who is the "net recipient" or "net supplier" of these interrelationships. The total amount of received production values could be treated as a variable of the welfare function of these persons.

Following the concepts of the "magic triangle" of input-output tables (see sections 13.2 to 13.4 of this chapter), the SAMIO is compiled in time units, in monetary units and in physical terms (tons). Differing from traditional concepts, the concepts of SAMIO are derived from considerations on the time use of the population. In this context, the pioneering work of Gary Becker and Graham Pyatt was very stimulating for developing suitable concepts (see Becker 1965 and Pyatt 1990, Kazemier and Exel 1992). A broader approach which is also based on welfare considerations was proposed by Gerhard Scherhorn (Scherhorn 2002 with further references). He also distinguishes welfare caused by goods and services, welfare connected with time use and welfare related to environmental conditions.

Data base for compiling SAMIO

An extended monetary input-output table, similar to the table described in section 13.4.2 (Table 13.4), is the starting point for the computation (Stahmer 2000, Stahmer et al. 2002). Table 13.7 shows this table which is based on 1990 data for Germany. The main differences refer to the treatment of education services, the concepts of household services and the disaggregation of the private consumption.

Education services (column 7 and row 7) are treated in a more conventional way. The gross output does not become part of fixed capital formation but is treated as government consumption. This concept also implies that the consumption of fixed produced assets does not include the consumption of education capital. Furthermore it is not necessary to introduce the margin of education as a balancing item.

The treatment of all household services as production activities has not changed (Becker 1964 and Lancaster 1966). According to this concept, consumer durables are investment goods which are depreciated. Differing from the input-output table in section 13.4.2, the labour inputs of household production (defined with the so-called third-person criterion) get no monetary value. Some changes have also been made with regard to the uses of household services. Household services related to employment (column 10 and row 10) are not treated as intermediate consumption but as private consumption. According to this concept, the balancing item of the margin of labour was not necessary. Corresponding with the treatment of education services, the household services related to studying (column 11 and row 11) do not use as fixed capital formation but as private consumption. No changes have been made in the cases of the use of household production services (column/row 9) and other household services (column 12 and row 12). Household production services are mainly intermediate input; other household services represent the main part of private consumption.

The column of private consumption is further subdivided by specific socio-economic groups of the population. The example in Table 13.7 shows a disaggregation by young people (0 - 18 years old), adults except aged persons (18 - 65 years old) and aged persons (65 years and older). The detailed breakdown of private consumption compiled for Germany 1990 comprises 32 types of households with further subdivisions by the persons living in the households (2 to 5 groups of persons).

Table 13.7: Extended monetary input-output table with disaggregation of private consumption

Billions of Deutsche Marks

Row No.	Uses / Supply	Input of branches										
		agricul-ture, forestry, fishing	mining, water and energy supply	manu-facturing	con-struc-tion	market services	environ-mental protec-tion services	educa-tion services	non-market services	house-hold produc-tion	services related to employ-ment	services related to study-ing
		1	2	3	4	5	6	7	8	9	10	11
	Product output by product group											
1	Prod. of agric., forestry, fishing	8		43		6	-		1	6		
2	Prod. of mining, water, energy	2	31	45	1	21	1	2	6	15		
3	Products of manufacturing	15	13	571	72	109	2	3	41	109	8	2
4	Construction work	1	4	7	4	23	2	1	7	1		-
5	Market services	8	16	289	40	425	2	8	109	128	20	10
6	Environmental protection services		1	5	2	2	5	1	1	3		
7	Education services		-	-	-	-	-	-	-	-	-	-
8	Non-market services		1	6	1	5	1		67	3		2
9	Household production services	-	-	-	-	-	-	-	-	42	-	6
10	Hh. serv. related to employment	-	-	-	-	-	-	-	-	-	-	-
11	Hh. serv. related to education	-	-	-	-	-	-	-	-	-	-	-
12	Other household services	-	-	-	-	-	-	-	-	-	-	-
13	Domestic products, totals	34	65	966	119	590	13	14	232	307	29	20
14	Compensation of employees	7	35	486	85	406	6	78	212	-	-	-
15	Net operating surplus	22	12	95	35	388	- 1		-	-	-	-
16	Non-deductible value added tax	-	-	-	-	12	1	1	14	23	3	1
17	Taxes less subsidies on products	- 5	- 3	55	2	23	-			-	-	-
18	Net value added	24	45	636	122	829	6	80	226	23	3	1
19	Cons. dom. prod. 2) invest. goods	10	18	62	5	141	6	8	8	23	10	2
20	Cons. imp. prod. 2) invest. goods	2	3	11	1	18		1	1	7	3	1
21	Non-deductible value added tax	-	-	-	-	11	-	-	3	4	2	
22	Imports of goods	6	13	225	13	30	1	1	14	42	5	1
23	Imports of services		1	9	1	23		1	6	5	2	1
24	Primary inputs, totals	43	80	942	142	1 052	14	90	258	104	24	6
25	Gross output, final uses	76	145	1 908.3	261	1 642	27	104	490	411	53	26
	Memorandum item:											
26	Time inputs (Millions of hours)	2 035	743	13 821	3 333	17 404	262	1 828	6 841	82 320	12 255	15 430

Row No.	Uses / Supply	Input of branches		Final uses								Total
				private consumption				fixed cap. form.				
		other services	Total	young persons persons	adults (except aged per-sons)	aged persons	govern-ment con-sump-tion 1)	fixed capital formation assets (except consumer sumer durables	con-sumer dura-bles	exports to the rest of the world	Total	Total
		12	13	14	15	16	17	18	19	20	21	22
	Product output by product group											
1	Prod. of agric., forestry, fishing	3	67	-	-	-	-	3	-	6	9	76
2	Prod. of mining, water, energy	18	141	-	-	-	-	- 1	-	4	3	145
3	Products of manufacturing	116	1 061	-	-	-	-	185	73	590	848	1 908
4	Construction work	2	53	-	-	-	-	205	-	3	208	261
5	Market services	403	1 457	-	-	-	-	33	41	112	185	1 642
6	Environmental protection services	7	27	-	-	-		-	-	-		27
7	Education services	-	-	-	-	-	104	-	-	-	104	104
8	Non-market services	21	106				381	1	-	2	383	490
9	Household production services	298	346	33	25	7	-	-	-	-	65	410
10	Hh. serv. related to employment	-	-	1	51	1	-	-	-	-	53	53
11	Hh. serv. related to education	-	-	17	8	1	-	-	-	-	26	26
12	Other household services	-	-	98	825	177	-	-	-	-	1 100	1 100
13	Domestic products, totals	869	3 258	148	909	187	484	426	114	716	2 983	6 241
14	Compensation of employees	-	1 316								-	1 316
15	Net operating surplus	-	551								-	551
16	Non-deductible value added tax	50	106	-	-	-	-	28	18	3	49	155
17	Taxes less subsidies on products	-	73								-	73
18	Net value added	50	2 046								-	2 046
19	Cons. dom. prod. 2) invest. goods	54	345	-	-	-	-	- 257	- 88	-	- 345	-
20	Cons. imp. prod. 2) invest. goods	14	61	-	-	-	-	- 37	- 25	-	- 61	-
21	Non-deductible value added tax	8	28	-	-	-	-	- 14	- 14	-	- 28	-
22	Imports of goods	70	420					66	32	47	146	566
23	Imports of services	34	83								1	83
24	Primary inputs, totals	231	2 983	-	-	-	-	- 242	- 94	48	- 288	2 695
25	Gross output, final uses	1 100	6 241	148	909	187	484	184	20	763	2 695	
	Memorandum item:											
26	Time inputs (Millions of hours)	397 824	554 097									

1) Including consumption of private non-profit institutions serving households (18,7 Bill.DM).
2) Including consumer durables.

Germany 1990

Table 13.8: Additional use tables

Billions of Deutsche Marks

Row No.	Uses / Supply	Input of branches: agricul-ture, forestry, fishing	mining, water and energy supply	manu-factur-ing	con-struc-tion	market services	environ-mental protec-tion services	educa-tion services	non-market services	house-hold produc-tion	services related to employ-ment	services related to study-ing
		1	2	3	4	5	6	7	8	9	10	11
	Product output by product group	**Consumption of fixed domestically produced assets**										
1	Prod. of agric., forestry, fishing	-	-	-	-	0.2	-	-	-	-	-	-
2	Prod. of mining, water, energy supply	-	-	-	-	-	-	-	-	-	-	-
3	Products of manufacturing	7.1	11.7	46.4	3.5	56.1	0.7	2.7	2.7	15.0	7.4	1.0
4	Construction work	2.3	4.9	9.5	0.6	71.7	5.4	4.2	5.2	-	-	-
5	Market services	0.9	1.0	5.5	0.5	12.8	0.1	0.5	0.5	7.9	2.2	0.6
6	Environmental protection services	-	-	-	-	-	-	-	-	-	-	-
7	Education services	-	-	-	-	-	-	-	-	-	-	-
8	Non-market services	-	-	0.1	-	0.4	-	-	-	-	-	-
9	Household production services	-	-	-	-	-	-	-	-	-	-	-
10	Hh. serv. related to employment	-	-	-	-	-	-	-	-	-	-	-
11	Hh. serv. related to education	-	-	-	-	-	-	-	-	-	-	-
12	Other household services	-	-	-	-	-	-	-	-	-	-	-
13	Total	10.3	17.6	61.5	4.6	141.3	6.2	7.5	8.4	22.9	9.6	1.6
	Product output by product group	**Imports from the rest of the world**										
1	Prod. of agric., forestry, fishing	1.5	0.0	15.6	0.0	1.8	-	0.0	0.7	8.9	0.1	0.0
2	Prod. of mining, water, energy supply	0.1	9.0	25.6	0.0	0.2	0.0	0.0	0.1	0.2	0.0	0.0
3	Products of manufacturing	5.8	7.0	195.4	13.7	45.5	0.9	1.4	13.7	39.8	7.8	1.6
4	Construction work	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	-
5	Market services	0.4	0.7	8.7	1.0	22.9	0.0	0.7	4.0	4.6	2.2	1.2
6	Environmental protection services	-	-	-	-	-	-	-	-	-	-	-
7	Education services	-	-	-	-	-	-	-	-	-	-	-
8	Non-market services	-	-	-	-	-	-	0.1	1.7	0.2	0.0	0.2
9	Household production services	-	-	-	-	-	-	-	-	-	-	-
10	Hh. serv. related to employment	-	-	-	-	-	-	-	-	-	-	-
11	Hh. serv. related to education	-	-	-	-	-	-	-	-	-	-	-
12	Other household services	-	-	-	-	-	-	-	-	-	-	-
13	Total	7.8	16.8	245.3	14.8	70.7	1.0	2.3	20.2	53.7	10.1	3.0
14	Goods	5.9	13.4	225.2	13.0	29.5	0.7	0.6	13.6	42.1	5.0	1.0
15	Services	0.4	0.7	8.6	1.0	22.9	0.0	0.9	5.7	4.8	2.2	1.4
16	Cons. of imported fixed assets 1)	1.5	2.7	11.4	0.7	18.3	0.3	0.9	0.9	6.8	2.9	0.6

Row No.	Uses / Supply	Input of branches: other services	Input of branches: Total	Final uses: private consumption: young persons persons	Final uses: private consumption: adults (except aged per-sons)	Final uses: private consumption: aged persons	Final uses: govern-ment con-sump-tion 1)	Final uses: fixed cap. form.: fixed capital formation assets (except consumer sumer durables	Final uses: fixed cap. form.: con-sumer dura-bles	Final uses: exports to the rest of the world	Final uses: Total	Total
		12	13	14	15	16	17	18	19	20	21	22
	Product output by product group			**Consumption of fixed domestically produced assets**								
1	Prod. of agric., forestry, fishing	-	0.2	-	-	-	-	- 0.2	-	-	- 0.2	-
2	Prod. of mining, water, energy supply	-	0.0	-	-	-	-	-	-	-	-	-
3	Products of manufacturing	33.1	187.6	-	-	-	-	- 131.0	- 56.5	-	- 187.6	-
4	Construction work	-	103.9	-	-	-	-	- 103.9	-	-	- 103.9	-
5	Market services	20.4	52.9	-	-	-	-	- 21.8	- 31.1	-	- 52.9	-
6	Environmental protection services	-	-	-	-	-	-	-	-	-	-	-
7	Education services	-	-	-	-	-	-	-	-	-	-	-
8	Non-market services	-	0.6	-	-	-	-	- 0.6	-	-	- 0.6	-
9	Household production services	-	-	-	-	-	-	-	-	-	-	-
10	Hh. serv. related to employment	-	-	-	-	-	-	-	-	-	-	-
11	Hh. serv. related to education	-	-	-	-	-	-	-	-	-	-	-
12	Other household services	-	-	-	-	-	-	-	-	-	-	-
13	Total	53.5	345.1	-	-	-	-	- 257.4	- 87.7	-	- 345.1	-
	Product output by product group			**Imports from the rest of the world**								
1	Prod. of agric., forestry, fishing	4.1	32.8	-	-	-	-	0.8	-	1.1	1.9	34.7
2	Prod. of mining, water, energy supply	0.2	35.3	-	-	-	-	- 0.1	-	0.0	0.0	35.3
3	Products of manufacturing	80.1	412.7	-	-	-	-	28.6	7.3	46.4	82.4	495.0
4	Construction work	0.0	0.5	-	-	-	-	0.4	-	0.0	0.4	0.9
5	Market services	32.8	79.3	-	-	-	-	0.0	0.0	0.2	0.2	79.5
6	Environmental protection services	-	-	-	-	-	-	-	-	-	-	-
7	Education services	-	-	-	-	-	-	-	-	-	-	-
8	Non-market services	1.4	3.6	-	-	-	-	-	-	-	-	3.6
9	Household production services	-	-	-	-	-	-	-	-	-	-	-
10	Hh. serv. related to employment	-	-	-	-	-	-	-	-	-	-	-
11	Hh. serv. related to education	-	-	-	-	-	-	-	-	-	-	-
12	Other household services	-	-	-	-	-	-	-	-	-	-	-
13	Total	118.6	564.2	-	-	-	-	29.8	7.4	47.8	84.9	649.1
14	Goods	70.2	420.1	-	-	-	-	66.3	31.9	47.4	145.6	565.7
15	Services	34.0	82.7	-	-	-	-	0.1	0.1	0.4	0.6	83.3
16	Cons. of imported fixed assets 1)	14.4	61.3	-	-	-	-	- 36.6	- 24.7	-	- 61.3	-

1) Including consumer durables

Germany 1990

The basic data deliver monetary information only on the households as a whole. The further breakdown by persons could partly be achieved by using simplified weighting systems (e.g. equivalent scales). Following this two-stage procedure, the whole population was disaggregated by 120 groups of persons. The main emphasis was laid on the situation of young people in different types of families.

As memorandum items, Table 13.7 also shows the direct time inputs of the different activities. In the case of employment (columns 1-8), the time inputs show the hours at the place of work.

For socio-economic analysis, it is preferable to endogenise the consumption of fixed produced assets. Finally, the use of fixed assets has also an intermediate character (Strassert and Stahmer 2002). Investment goods are directly or indirectly inputs for producing private or government consumption goods and services, other investment goods or exports. Input-output models can reveal these linkages between inputs and final uses. As a necessary data base for input-output analysis, the depreciation items of the different industries (branches) are subdivided by the type of investment goods. For modelling purposes, these data are treated as additional intermediate inputs. In accordance with this concept, the primary inputs (third quadrant of the input-output table) only comprise imports for intermediate uses and net value added. An additional correction has to be made in the second and respectively in the fourth quadrant. The columns of fixed capital formation are reduced by the corresponding items of depreciation showing only net capital formation.

Thus, the row sums of total uses of depreciation will become zero. Table 13.8 shows such a matrix for the consumption (depreciation) of domestically produced assets and the corresponding corrections. Row 13 of Table 13.8 corresponds with row 19 of Table 13.7.

Socio-economic activities are not only based on the use of domestic product but also directly or indirectly linked with imported goods and services. For analysing the impacts of foreign trade in the countries of origin it is necessary to endogenise not only the consumption of fixed assets but also the intermediate inputs of imports.

A thorough analysis of the production activities abroad would only be possible if input-output tables of all important countries delivering import goods were available. For getting first estimates, it is possible to apply the domestic input structures also for describing foreign production activities. Of course, such an assumption neglects the fact that many important products are not domestically produced. Table 13.8 also shows an import matrix which is used for input-output analysis in the following sections. It should be mentioned that this import matrix also contains a depreciation matrix for the imported investment goods with corresponding corrections in the columns of fixed capital formation. The data on imports correspond with the figures in Table 13.7, rows 20, 22 and 23.

For linking environmental aspects with the socio-economic data base of input-output tables, material balances are used which give a complete description of all physical inputs and outputs of the different industries (branches). In section 13.4.3, such material balances are described as supplementary data. The data used in the context of describing ecological aspects of the SAMIO in section "SAMIO in physical units" are shown in Table 13.9.

In linking physical flows with the monetary data of the extended input-output table, only parts of the material balances are used. Physical flows which are not further taken into account are indicated by italic letters. With regard to the product flows, all intermediate domestic products (rows 2 and 17) will be excluded. Remaining product flows are only the imports of intermediate products (row 3), exports of goods (row 19) and the physical flows of investment goods (row 18). In the case of raw materials and residuals, all throughput materials (row 8 and row 20) are excluded. These materials comprise cooling water or soil excavation for structures which are used as raw materials and which are given back to nature as residuals without any further economic treatment. Furthermore, residuals which are still treated or re-used for economic purposes (row 5 and row 21), are excluded. The remaining residuals (rows 23 to 28) which are linked with socio-economic data in the model described in section "SAMIO in physical units", are stored in controlled landfills (like waste) or are disposed back into nature (e.g. air pollution or treated waste water). In the case of natural resources, only those are taken into account in socio-economic modelling which are used as inputs of economic activities (row 9 to row14).

Table 13.9: Material balances

Millions of tons

		Input of branches												
										Household services				
		Agriculture, forestry and fishing	Mining, water and energy supply	Manufacturing	Construction	Market services	Environmental protection services	Education services	Non-market services	Household services	Services reated to employment	Services related to studying	Other services	Total
		1	2	3	4	5	6	7	8	9	10	11	12	13
							Input							
1	**Product inputs**	199	2 141	2 202	618	148	17	52	333	802	75	37	2 201	8 825
2	Domestic origin	188	2 092	1 963	590	134	17	52	331	783	71	36	2 180	8 438
3	Imported	10	49	239	28	13	0	0	2	19	4	1	21	387
4	**Residual inputs for economic treatment or re-use**	-	1	13	9	104	4 461	0	0	1	0	0	2	4 591
5	Current production	-	-	3	0	104	4 461	0	0	-	-	-	-	4 569
6	Fixed produced assets	-	1	9	9	0	-	0	0	1	0	0	2	22
7	**Natural resource inputs of throughput materials**	-	32 386	5 346	113	-	3 500	-	-	-	-	-	-	41 345
8	**Other natural resource inputs**	607	5 839	1 139	68	118	10	15	90	94	29	5	152	8 165
9	Energy carries	-	193	-	-	-	-	-	-	-	-	-	-	193
10	Other solid materials	1	25	591	56	-	-	-	1	-	-	-	-	673
11	Water raised	262	5 361	373	4	28	-	13	77	15	1	1	42	6 177
12	Oxygen	33	258	175	8	90	10	2	12	79	28	4	110	810
13	Carbon dioxide	311	-	-	-	-	-	-	-	-	-	-	-	311
14	Other air components	-	1	-	-	-	-	-	-	-	-	-	-	1
15	**Totals**	806	40 367	8 699	808	370	7 988	67	423	897	105	42	2 354	62 926
							Output							
16	**Domestic product outputs**	251	6 961	1 361	540	99	0	-	17	36	-	-	-	9 266
17	Intermediate products	194	6 935	1 187	6	80	0	-	0	36	-	-	-	8 438
18	Gross capital formation	47	-	18	534	7	-	-	17	-	-	-	-	622
19	Exports	10	27	156	0	13	-	-	-	-	-	-	-	206
20	**Residual outputs of throughput materials**	-	32 386	5 346	113	-	3 500	-	-	-	-	-	-	41 345
21	**Residual outputs for economic treatment or re-use**	27	102	1 237	80	114	13	49	299	660	60	32	1 896	4 569
22	**Other residual outputs**	527	918	755	75	157	4 475	18	107	201	45	10	459	7 746
23	Waste	253	18	116	58	20	44	0	2	3	0	0	27	541
24	Waste water	-	18	184	-	-	4 395	-	-	1	0	0	3	4 600
25	Water vaporised	13	606	283	8	54	22	15	93	126	20	6	321	1 567
26	Oxygen	226	-	-	-	-	-	-	-	-	-	-	-	226
27	Carbon dioxide	34	274	161	7	80	12	2	12	68	24	4	99	778
28	Other air emissions	2	2	11	1	4	1	0	0	3	1	0	9	34
29	**Total**	806	40 367	8 700	808	370	7 988	67	423	897	105	42	2 354	62 926

Germany 1990

SAMIO in time units

The social accounting matrix based on input-output analysis (SAMIO) focusses on the activities of the population disaggregated by socio-demographic or socio-economic groups of persons. A very simple disaggregation of the population is used as an example in this chapter: The population is only subdivided according to age. The chosen three groupings of the population are young people (0 to 18 years old), adults except seniors (18 to 65 years old) and aged persons (65 years and older). In Germany 1990, 11.6 million persons belonged to the young people, 42.0 to the adults except seniors and 9.7 to the aged people. Other possible classifications could be types of households, education levels or sex.

A starting point for constructing a SAMIO is the total amount of hours available in one year to the different groups of population. It is easy to compile these data because the yearly time budget is fixed (8 760 hours per person, in leap years 8 736 hours). In row 14 and columns 1 to 3 of Table 13.10, the available time of the three groups of population is recorded. These figures could be interpreted as the total supply of time.

Table 13.10: Social accounting matrix in time units based on input-output analysis (SAMIO – T)

Billions of hours

No.	USES / SUPPLY	Personal activities			Household activities		Employment							
							Final consumption							
		Young persons (up to 17 years old)	Adults (excl. aged persons)	Aged persons (65 years and older)	Unpaid services within households	Unpaid services between households	Private consumption	Services of NPISH 1)	Education services	Health services	Other government services	Net fixed capital formation	Exports of products	Total uses
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Young persons (until 17 years old)	97.7			2.5	0.1	0.7				0.1		0.1	101.2
2	Adults (excl. aged persons)		249.4		57.9	4.1	21.2	0.7	3.0	3.9	6.9	4.9	16.0	368.0
3	Aged persons (65 years and older)			66.1	16.7	1.0	0.9			0.1	0.1			84.9
4	Unpaid services within households	15.2	45.2	16.7										77.1
5	Unpaid services between households	1.3	2.1	1.8										5.2
6	Private consumption	2.7	16.7	3.4										22.8
7	Services of NPISH 1)	0.1	0.5	0.1										0.7
8	Education services	1.8	1.1	0.1										3.0
9	Health services	0.4	2.2	1.4										4.0
10	Other government services	1.3	4.7	1.1										7.1
11	Net fixed capital formation													0.0
12	Imports of products	1.4	8.2	1.8								1.9	5.6	18.9
13	Balances	-20.7	37.9	-7.6								-6.8	-2.8	0.0
14	Total supply	101.2	368.0	84.9	77.1	5.2	22.8	0.7	3.0	4.0	7.1	0.0	18.9	

Memorandum item

Population (1.000 persons) 11 551 42 006 9 693

1) Non-profit institutions serving households

Germany 1990

The use of the time budget of the age groups is shown in the first three rows of Table 13.10. Three different types of time use are distinguished:

- personal activities which are undertaken for own purposes only (columns 1 to 3),
- unpaid household production activities done not only for own purposes but also for other members of the same household or for members of other households (columns 4 to 6) and
- paid employment activities which aim at producing marketed or non-marketed products.

The figures of the first two categories were estimated using the data of the time budget survey 1991/92. In the case of employment, the totals are also recorded in the time budget survey. The disaggregation of hours worked according to the different types of final uses and the age groups can only be made by input-output analysis. The directly and indirectly necessary labour hours of the different socio-economic groups of the population to produce the different types of final uses can be estimated by the following equations:

(1) $$T^{P}_{dom} = T_{SAM}\ B_{dom}\ Y_{dom} \quad \text{with}$$

(2) $$T_{SAM} = \begin{pmatrix} t_1 \\ . \\ . \\ . \\ t_n \end{pmatrix} \qquad i = 1,\dots, n$$

(3) $$B_{dom} = (I - A_{dom} - D_{dom})^{-1}$$

t_i row vector of labour hour coefficients (including travelling time to the working place) of the socio-economic group i related to the monetary gross output by branch[8]

A_{dom} coefficient matrix of (monetary) intermediate inputs of domestic products related to (monetary) gross output by product group and branch

D_{dom} coefficient matrix of (monetary) consumption of fixed produced assets (domestic production) related to (monetary) gross output by investment good and branch

Y_{dom} matrix of (monetary) final uses of domestic products by product group and category of final uses

It should be mentioned that in Table 13.10 the hours worked which are necessary to produce investment goods refer to net investment only. Labour hours directly and indirectly necessary for reproducing depreciated investment goods are associated with the other final uses (private consumption, government consumption, exports).

The breakdown of labour hours by age group and branch is part of a SAM module describing the paid working hours disaggregated according to different socio-demographic and socio-economic criteria (see the module time accounts (TA) in Figure 13.1). In the case of the chosen age groups, it was only necessary to distribute a few labour hours of young and aged persons among the different branches because their participation in paid employment is low. Table 13.10 reveals the expected result that most of the hours spent for paid employment are associated with persons aged from 18 to 65 years.

The first three columns of Table 13.10 show the beneficiaries of the time spent. The three age groups of the population receive

- hours of personal activities from themselves (rows 1 to 3),
- hours of household production from themselves, from other members of the same household or from members of other households (rows 4 and 5) and
- hours of paid employment activities as far as they consume products which are directly or indirectly produced by these labour hours.

The distribution among the beneficiaries of the hours of household production activities could partly be compiled by the results of specific questions of the time budget survey. In several cases, the distribution could only be roughly estimated using suitable ratios of distribution (e.g. number of persons in the different types of household).

[8] The time inputs of private activities are not taken into account. The row vector contains zeros for these branches.

The distribution of the labour hours directly and indirectly necessary for producing consumption goods and services (row 6) for the different age groups of population could be estimated by using equation (4):

(4) $t^{u}_{dom} = t \ B_{dom} \ Y_{SAM}$ with

(5) $Y_{SAM} = (C_1 \dots C_m \ \ inv' \ \ ex')$ and

$i = 1, \dots, n$

(6) $t = \sum_{i=1}^{n} t_i$

Y_{dom} and Y_{SAM} are related in the following way:

(7) $Y_{dom} = (C \ \ inv' \ \ ex')$ with

(8) $C = \sum_{i=1}^{n} C_i$

C_i matrix of (monetary) final consumption of the socio-economic group i by product group and category of final consumption

inv' column vector of net fixed capital formation by product group

ex' column vector of exports of goods and services by product group

According to equation (5), the disaggregation of final uses by socio-demographic/economic groups not only contains a breakdown of private consumption (as it is done in Table 13.7) but is also extended to the consumption of non-profit institutions serving households (NPISH) and government consumption. For a comprehensive socio-economic analysis, the beneficiaries of non-market services should be identified. These services comprise parts of individual consumption which could be associated with specific groups of persons without greater difficulties and collective consumption which are provided simultaneously to all members of the community (see ESA, par. 3.83).

In our numerical example, private consumption (row 7) can be subdivided by 120 groups of persons in 32 types of households. For calculating Table 13.10, the socio-economic classification was aggregated to the three age groups. The distribution of education services (row 8) among the age groups of pupils was relatively easy. In the input-output table used as data base, ten different types of institutions delivering education services were distinguished from kindergarten up to university (Ewerhart 2001). The distribution of the other services of government and of the non-profit institutions serving households among the age groups of population was estimated based on quotas which were derived from different sources. In the case of health services (row 9), detailed data of the health insurance companies could be used. It should be mentioned that the health services only comprise the non-marketed part. Services directly paid by households are recorded as private consumption. As far as no special key was available, the final consumption items were distributed according to the number of persons in each age group.

The population not only consumes domestic products but also imported goods and services. Thus, labour hours abroad are necessary to produce directly or indirectly the products which are delivered to the importing country. If no information on the input-output relations in countries producing import products were available, it seems acceptable to use the assumption of same input coefficients for producing domestic and imported products. The results could be interpreted as the opportunity costs of producing in one's own country instead of importing these products.

The calculation of the labour hours directly and indirectly necessary to produce imported products abroad follows the following equation:

(9) $t_{imp} = t \ B \, A_{imp} \ B_{dom} \ Y_{SAM}$

$+ \, t \ B \, Y_{imp}$

with

(10) $$B = (I - A_{dom} - D_{dom} - A_{imp})^{-1}$$

A_{imp} coefficient matrix of (monetary) intermediate inputs of imported products (including consumption of imported investment goods) related to (monetary) gross output by product group and branch

Y_{imp} matrix of (monetary) final uses of imported products by product group and category of final uses

In equation (9) the first term on the right side comprises the labour hours directly and indirectly necessary to produce imported intermediate products (including also imported products for private consumption). The second term denotes the labour hours necessary for producing directly imported products for final uses which comprise investment goods and directly re-exported import products.

The indirectly imported labour hours which are associated with the three age groups of population (row 12 of Table 13.10) only comprise hours necessary for producing imported intermediate inputs which are directly or indirectly used for the production of final consumption. Differing from the domestic production (see rows 6 to 10 of Table 13.10), no breakdown by type of final consumption is shown in the table.

The data for (net) capital formation and exports (row 12, columns 11 and 12 of Table 13.10) are an addition of the labour hours of intermediate imports indirectly necessary for producing these types of final uses and the labour hours necessary for the directly imported products of final uses.

The totals of all hours received by the different socio-economic groups could be interpreted as inputs of their welfare function. Young people benefited from 122 billion hours, adults (except senior citizens) from 330 billion hours and aged people from 93 billion hours (rows 1 to 12, columns 1 to 3 of Table 13.10). In comparison with the number of persons belonging to the age groups, young people receive 10 550 hours per head, adults (except aged persons) only 7 860 and aged people 9 540 hours per head. These figures could be compared with the annual hours of each person (8 760).

In row 13 of Table 13.10, the time delivered and the time received are balanced. This balancing procedure is shown for the different age groups of the population, for the foreign trade and for fixed capital formation.

In the case of the socio-economic groups, the balancing items reveal the social position of each respective group. Because of the great amount of their employment work and their unpaid household production, adults (younger than 65 years) deliver much more time than they receive. Apart from their personal time of 250 billion hours, they spend 118 billion hours on work for others. On the other hand, they receive only 80 billion hours from others. Thus, they have a net spending of 38 billion hours.

In our highly aggregated example, the other two age groups are the beneficiaries. Young people only spend less than 4 billion hours for others but receive nearly 25 billion hours: They have a “deficit” of about 21 billion hours. This amount represents the investment of society in the young generation.

In the case of aged persons, the “time account” also has a negative balancing item (8 billion hours). Apart from their private time (66 billion hours), the time of their own social work amounts to 19 billion hours which especially contains hours of household work. On the other hand, they receive 27 billion hours which also contain the hours necessary for producing goods and services consumed by aged persons.

Society not only invests in the young generation but also in extended production facilities. In our example, net capital formation has a positive amount (7 billion hours). This amount is balanced in row 13 of Table 13.10 by the corresponding negative item.

In the case of Germany, the foreign trade with products shows a surplus of exports in comparison with the imports (exports: 22 billion hours, imports: 19 billion hours). This surplus (3 billion hours) is balanced by the corresponding negative item in row 13 of table 13.11 which is lastly delivered by the age group actively involved in economic production (18 to 65 years old).

SAMIO in monetary units

The SAMIO in time units also delivers the basic scheme for the SAMIO in monetary units. For socio-economic analysis, it seems to be preferable to apply specific concepts which do not automatically accept the dominance of economic monetary thinking. The time use data of the population could be taken as a suitable starting point.

The starting point of the monetary SAMIO which is presented in Table 13.11 are the figures for net value added (including the value of household work) which are distributed among the three age groups of the population according to their participation in the different production activities (row 14, columns 1 to 3). Differing from the SAMIO in time units, these values could only be determined by firstly estimating the uses of the monetary values (rows 1 to 3 in Table 13.11).

The time used for personal activities (rows 1 to 3, columns 1 to 3) does not get a monetary value. The values of household work (rows 1 to 3, columns 4 and 5) are easily compiled by multiplying the figures of time use by a suitable wage rate. In the German case, the wage rate of a domestic servant (the so-called generalist) has been used (Lützel 1989, Schäfer and Schwarz 1995). Of course, other types of valuation (e.g. the wage rates of specialists) could easily be introduced.

Table 13.11: Social accounting matrix in monetary units based on input-output analysis (SAMIO – M)

Billions of Deutsche Marks

No.	USES / SUPPLY	Personal activities			Household activities		Employment							
							Final consumption							
		Young persons (up to 17 years old)	Adults (excl. aged persons)	Aged persons (65 years and older)	Unpaid services within households	Unpaid services between households	Private consumption	Services of NPISH 1)	Education services	Health services	Other government services	Net fixed capital formation	Exports of products	Total uses
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Young persons (up to 17 years old)	0.0			25.4	1.3	28.1				2.9		3.5	61.2
2	Adults (excl. aged persons)		0.0		598.8	46.0	846.9	17.1	97.8	117.6	195.2	164.5	556.3	2640.2
3	Aged persons (65 years and older)			0.0	170.7	10.9	37.2			3.9	2.8			225.5
4	Unpaid services within households	158.8	465.4	170.7										794.9
5	Unpaid services between households	14.5	23.8	19.9										58.2
6	Private consumption	108.5	666.0	137.7										912.2
7	Services of NPISH 1)	3.1	11.4	2.6										17.1
8	Education services	61.8	35.0	42.2										139.0
9	Health services	11.8	67.5	30.8										110.1
10	Other government services	36.7	133.4	1.1										171.2
11	Net fixed capital formation													0.0
12	Imports of products	49.2	270.8	58.3								67.1	203.6	649.0
13	Balances	-383.2	966.9	-237.7								-231.6	-114.4	0.0
14	Total supply	61.2	2640.2	225.6	794.9	58.2	912.2	17.1	97.8	121.5	200.9	0.0	649.0	

Memorandum item

Population (1.000 persons) 11 551 42 006 9 693

1) Non-profit institutions serving households

Germany 1990

Similar to the procedure in the case of time units, the monetary values of the different final uses associated with the socio-economic groups as employed persons (rows 1 to 3, columns 6 to 12 of Table 13.11) are estimated by linking net value added and final uses within an input-output model:

(11) $$M^{P}_{dom} = NVA_{SAM}\ B_{dom}\ Y_{dom} \quad \text{with}$$

(12) $$NVA_{SAM} = \begin{pmatrix} nva_1 \\ . \\ . \\ . \\ nva_n \end{pmatrix} \qquad i = 1,\ldots n$$

nva_i row coefficient vector of net value added produced by the employed persons of socio-economic group i related to the monetary gross output by branch (with zeros in the case of the branches of private activities)

In our example, the contribution of the employed persons of the different socio-economic groups to the production of the branch where they are employed is estimated using the ratios of distribution of the labour hours of the employed persons. Of course, other quota could also be applied.

In the rows 4 and 5 of Table 13.11 the valued hours of household production are distributed among the age groups benefiting from these services. Because of the unique type of monetarisation (only "generalists"), the quota of the age groups are very similar to those of Table 13.10.

In the rows 6 to 10 of Table 13.11, the net value added associated with the final uses is distributed among the beneficiaries of these products. The compilation method corresponds with the procedure already described in equation (4):

(13) $$m^{u}_{dom} = nva\ B_{dom}\ Y_{SAM} \quad \text{with}$$

(14) $$nva = \sum_{i=1}^{n} nva_i$$

The monetary values of imported products are linked with the final consumption of the age groups of population, with net capital formation and with exports in row 12 of Table 13.11. In this case, it is not necessary to take into account the production facilities abroad. The imported values are directly associated with the final uses by the following equation (15):

(15) $$m^{u}_{imp} = (1\ldots1)\,(A_{imp}\ B_{dom}\ Y_{SAM} + Y_{imp})$$

The total monetary values received by the different socio-economic groups (rows 1 to 12, columns 1 to 3 of table 13.12) could be interpreted as a monetary contribution to their welfare functions. The young persons receive 444 billion Deutsche Mark (38 480 DM per head), the adults (except seniors) 1 673 billion Deutsche Mark (39 830 DM per head) and the aged persons 464 billion Deutsche Mark (47 790 DM per head). In the case of young people, the high costs of education within and outside households strongly influence the result. In the case of aged persons, the high amount of care within households and the high health expenditures determine the level of total costs.

The balancing items shown in row 13 of Table 13.11 could be interpreted in the same way as already done in the case of time units. The adults (with age from 18 to 65 years) deliver values of 967 billion Deutsche Mark to the other two age groups (383 and 238 billion Deutsche Mark respectively), to future economic activities (net investment: 232 billion Deutsche Mark) and to other countries (export surplus: 114 billion Deutsche Mark).

The description of the compilation methods may have revealed already the close linkages between the SAMIOs in time and monetary units. Apart from the time used for personal activities (rows 1 to 3, columns 1 to 3), monetary and time data could also be interpreted simultaneously: The time data represent the direct and indirect time inputs to produce the monetary values. On the other side, the monetary data can be interpreted as the values given to the time received or spent by the different groups of the population.

SAMIO in physical units

Comprehensive studies on possibilities to achieve paths of sustainable development imply an integrated social, economic and environmental analysis. Very similar to the concepts applied in SESAME, data on natural resources and residuals could be linked with the social and economic information given in SAMIO.

These linkages are based on the complete material balances which have already been described (see Table 13.9) and the consistent presentation of physical flows in physical input-output tables presented in section 13.4.3 (with Table 13.4) of this chapter. In contrast to the approach chosen in these tables, only specific physical flows which belong either to the primary inputs or to the final uses are chosen for further analysis. These physical flows comprise natural resources which are used as intermediate inputs of economic activities and residuals which leave the economic cycle and are stored in controlled landfills (e.g. waste) or disposed again into the nature (e.g. air emissions or treated waste water). In Table 13.9, these physical flows have already been indicated.

Apart from the mentioned flows of natural resources and residuals, specific physical product inputs and outputs could be taken into account: Imported intermediate inputs are part of the primary inputs, investment goods and exports of goods are part of the final uses in physical accounting. Nevertheless, these physical flows were excluded because they are represented in the SAMIO by the natural resources directly or indirectly necessary to produce them. This treatment does not exclude a supplementary analysis of these flows in the context of balancing transboundary flows or accounting the changes of physical assets. For such studies, the figures of table 13.19 deliver a suitable data base.

The physical flows are associated with the activities of the different age groups of population in the next two tables. Table 13.12 shows the use of natural resources, Table 13.13 the mentioned residuals flows.

Table 13.12: Social accounting matrix in physical units based on input-output analysis (SAMIO – P) – Natural resource input

Million of tons

No.	USES / SUPPLY	Personal activities			Household activities		Employment							Total uses
							Final consumption							
		Young persons (up to 17 years old)	Adults (excl. aged persons)	Aged persons (65 years and older)	Unpaid services within households	Unpaid services between households	Private consumption	Services of NPISH 1)	Education services	Health services	Other government services	Net fixed capital formation	Exports of products	
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Young persons (up to 17 years old)	17			3	0	137				7		12	176
2	Adults (excl. aged persons)		143		66	6	4119	37	175	240	496	535	1930	7747
3	Aged persons (65 years and older)			26	20	0	181			8	7			242
4	Unpaid services within households	18	57	14										89
5	Unpaid services between households	1	2	3										6
6	Private consumption	537	3222	678										4437
7	Services of NPISH 1)	7	24	6										37
8	Education services	108	64	3										175
9	Health services	24	138	86										248
10	Other government services	93	339	78										510
11	Net fixed capital formation													0
12	Imports of products	264	1464	314								280	1033	3355
13	Balances	-893	2294	-966								-815	380	0
14	Total supply	176	7747	242	89	6	4437	37	175	248	510	0	3355	

Memorandum item

Population (1.000 persons) 11 551 42 006 9 693

1) Non-profit institutions serving households

Germany 1990

The input-output models used for estimating these linkages correspond with the models already described in section “SAMIO in time units”. For calculating the physical flows connected with the groups of population as producers, the following equation can be used:

$$(16) \qquad P^{p}_{dom} = \begin{pmatrix} NR_{SAM} \\ RS_{SAM} \end{pmatrix} B_{dom} \; Y_{dom}$$

with

$$(17) \qquad NR_{SAM} = \begin{pmatrix} NR_1 \\ . \\ . \\ . \\ NR_n \end{pmatrix} \qquad i = 1,\ldots, n$$

and

$$(18) \qquad RS_{SAM} = \begin{pmatrix} RS_1 \\ . \\ . \\ . \\ RS_n \end{pmatrix} \qquad i = 1,\ldots, n$$

NR_i coefficient matrix of physical inputs of domestic natural resources used by the socio-economic group i related to (monetary) gross output by type of natural resources and branch

RS_i coefficient matrix of residuals produced by the socio-economic group i related to (monetary) gross output by type of residuals and branch

Table 13.13: Social accounting matrix in physical units based on input-output analysis (SAMIO – P) – Residual outputs

Million of tons

No.	USES / SUPPLY	Personal activities			Household activities		Employment							
							Final consumption							
		Young persons (up to 17 years old)	Adults (excl. aged persons)	Aged persons (65 years and older)	Unpaid services within households	Unpaid services between households	Private consumption	Services of NPISH 1)	Education services	Health services	Other government services	Net fixed capital formation	Exports of products	Total uses
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Young persons (up to 17 years old)	48			38	1	140				6		9	242
2	Adults (excl. aged persons)		390		124	3	4226	18	159	155	391	267	1463	7196
3	Aged persons (65 years and older)			76	28	7	186			5	6			308
4	Unpaid services within households	38	124	28										190
5	Unpaid services between households	1	3	7										11
6	Private consumption	554	3303	695										4552
7	Services of NPISH 1)	3	12	3										18
8	Education services	99	58	2										159
9	Health services	15	89	56										160
10	Other government services	73	268	62										403
11	Net fixed capital formation													0
12	Imports of products	184	1020	222								198	771	2395
13	Balances	-773	1929	-843								-465	152	0
14	Total supply	242	7196	308	190	11	4552	18	159	160	403	0	2395	
	Memorandum item													
	Population (1.000 persons)	11 551	42 006	9 693										

1) Non-profit institutions serving households

Germany 1990

As opposed to the distribution of time units among the different socio-economic groups, complete matrices of natural resource inputs and residual outputs have to be estimated for each socio-economic group. In our numerical example, the calculation of the distribution of the physical flows among the socio-economic groups as producers is based on very simple assumptions (e.g. quota of labour hours by branch). In the case of private activities, two types of environmental impacts have to be distinguished: Impacts of producing the intermediate inputs of private activities and impacts of the production processes of the private activities themselves. In the first case, households are only indirectly responsible, in the second case they immediately produce residuals and use natural resources. In Tables 13.12 and 13.13, the direct environmental impacts are shown in the rows 1 to 3 of the columns 1 to 5, the indirect impacts which are connected with employment work, are recorded in the rows 1 to 3 of column 6. To achieve this breakdown, submatrices of NR_{SAM} and RS_{SAM} were used which only contain data on the activities which are intended to be shown separately.

A similar procedure was necessary in the case of identifying the environmental impacts of the socio-economic groups as users. The basic equation was

(19) $$M^{U}_{dom} = \begin{pmatrix} NR \\ RS \end{pmatrix} B_{dom} \; Y_{SAM}$$

with

(20) $$NR = \sum_{i-1}^{n} NR_i \quad \text{and}$$

(21) $$RS = \sum_{i-1}^{n} RS_i$$

For separating the direct from the indirect environmental impacts of private activities, submatrices of NR and RS were necessary. The rows 1 to 5 of columns 1 to 3 of the Tables 13.12 and 13.13 show the direct impacts connected with private activities, row 6 of columns 1 to 3 the indirect impacts of private consumption. The rows 7 to 10 of columns 1 to 3 show the environmental impacts of the other final consumption distributed among the age groups of the population as users.

The SAMIO in physical units not only describes the domestic physical flows but also the use of natural resources and the production of residuals abroad which is connected with the production of imported goods and services. In studies of the Wuppertal Institute (Germany), these flows are indicated as “backpacks” of domestic production. Detailed analysis is necessary for estimating these rucksacks in a suitable manner. For simplifying the compilation procedure, the presented example is based on the assumption that the production processes in the home country and abroad are identical. Following this simple approach, equation (22) could be applied:

(22) $$M^{U}_{imp} = \begin{pmatrix} NR \\ RS \end{pmatrix} B \, A_{imp} \; B_{dom} \; Y_{SAM} + \begin{pmatrix} NR \\ RS \end{pmatrix} B \, Y_{imp}$$

The results of this calculation of the uses of natural resources are shown in row 12 of Table 13.12. The data on the production of residuals linked with the socio-economic groups, the net investment and the exports are presented in row 12 of Table 13.13.

Table 13.14 and Table 13.15 show the information on natural resources and residuals in a breakdown by different types of materials using a simplified version of the Tables 13.12 and 13.13. Such differentiation is especially necessary to separate the huge amounts of water raised and waste water from the other flows. Furthermore, detailed information on specific natural resources and emissions is necessary for further analysis of environmental themes as it is proposed in the NAMEA framework mentioned.

Table 13.14: Social accounting matrix in physical units based on input-output analysis (SAMIO – P) – Natural resource inputs by type of resource

Million of tons

No.	USES / SUPPLY	Personal activities			Household production		Employment			Demostic environment		Export of		
		Young persons	Adults (excl. aged persons)	Aged persons	Services within households	Services between households	Private consumption	Net fixed capital formation	Exports of products	Natura resources	Residuals	Natural resources	Residuals	Total uses
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Young persons										176			176
2	Adults (excl. aged persons)										7 747			7 747
3	Aged persons										242			242
4	Services within households													
5	Servces betrween households													
6	Final consumption													
7	Net fixed capital formation													
8	Exports of products													
9	Domestic natural resources													
10	Domestic residuals	805	3 989	894				535				1 942		8 165
	Waste	15	73	16				3				87		194
	Waste water	43	195	44				214				176		672
	Water vaporized	641	3 170	714				272				1 380		6 177
	Oxygen	77	396	86				37				212		808
	Carbon dioxide	29	154	34				9				86		312
	Other air emissions		1									1		2
11	Foreign natural resources													
12	Foreign residuals	264	1 464	314				280				1 033		3 355
	Waste	27	145	30				20				102		324
	Waste water	20	102	22				50				135		329
	Water vaporized	163	922	199				172				632		2 088
	Oxygen	24	130	28				29				109		320
	Carbon dioxide	30	164	35				9				54		292
	Other air emissions		1									1		2
13	Balances	- 893	2 294	- 966				- 815				380		0
14	Total supply	176	7 747	242				0			8 165	3 355		

Germany 1990

Table 13.15: Social accounting matrix in physical units based on input-output analysis (SAMIO – P) – Residual outputs by type of residual

Million of tons

No.	USES / SUPPLY	Personal activities			Household production		Employment			Demostic environment		Export of		Total uses
		Young persons	Adults (excl. aged persons)	Aged persons	Services within households	Services between households	Private consumption	Net fixed capital formation	Exports of products	Natura resources	Residuals	Natural resources	Residuals	
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Young persons										242			242
2	Adults (excl. aged persons)										7 196			7 196
3	Aged persons										308			308
4	Services within households													
5	Servces betrween households													
6	Final consumption													
7	Net fixed capital formation													
8	Exports of products													
9	Domestic natural resources													
10	Domestic residuals	831	4 247	929				267					1 472	7 746
	Waste	46	243	53				48					152	542
	Waste water	523	2 677	583				115					702	4 600
	Water vaporized	164	821	184				59					338	1 566
	Oxygen	21	112	24				6					62	225
	Carbon dioxide	74	378	82				37					208	779
	Other air emissions	3	16	3				2					10	34
11	Foreign natural resources													
12	Foreign residuals	184	1 020	222				198					771	2 395
	Waste	33	183	40				20					90	366
	Waste water	69	388	85				90					345	977
	Water vaporized	37	201	44				51					187	520
	Oxygen	21	119	26				7					40	213
	Carbon dioxide	23	123	26				29					104	305
	Other air emissions	1	6	1				1					5	14
13	Balances	- 773	1 929	- 843				- 465					152	0
14	Total supply	242	7 196	308				0			7 746		2 395	

Germany 1990

The flows of natural resources and residuals are recorded as flows between the domestic economy and the natural environment of the own country and of the rest of the world. The totals of the rows 9 and 11 of the columns 1 to 3 in Table 13.14 correspond with the totals of the rows 1 to 10 and 12 respectively of the columns 1 to 3 in Table 13.13. In the same way, the totals of the rows 10 and 12 of the columns 1 to 3 in Table 13.14 could be found as totals of the rows 1 to 10 and 12 respectively of the columns 1 to 3 in Table 13.13.

The balances of natural resources and residuals are shown in row 13 of the tables 13.13 and table 13.13 respectively. In the case of physical flows, the imports play a more important role than the exports. Thus, the balance of exports and imports shows a surplus of foreign natural resources (380 million tons) and of foreign residuals (152 million tons).

Outlook

The concepts of SAMIO presented could only provide a starting point for further discussions. One field of research could be the integration of such data with econometric and general equilibrium models (Frohn 2001 and Frohn 2002). Furthermore, it could be analysed to which extent such tables could be applied for welfare analysis. Nevertheless, future work has to focus on an improvement of the data base available. The implementation of the SESAME concepts in a number of countries is an important and encouraging step towards this aim.

Updating and projecting input-output tables

chapter 14

14.1 Introduction

In recent years, some countries have considerably reduced the time lag for the publication of input-output tables. However, the problem remains that many applications of input-output analysis are obsolete because the database is outdated. It is costly to establish harmonised input-output tables for the Member States of the European Union, as they rely to a great extent on surveys and primary statistics. Since 2002, the Member States are requested to report annual supply and use tables and five-yearly input-output tables in accordance with the official transmission programme for the European System of National Accounts (ESA 1995). As supplement for the years in-between, but also to cover the time lag between the last submitted input-output table and the most recent set of national accounts, updates of input-output tables might be estimated by a new methodology. The proposed updating procedure for input-output tables avoids arbitrary changes of important input coefficients, which sometimes occur if traditional RAS-procedures are applied.

Methods for updating input-output tables can be categorised in univariate, bivariate, econometric and stochastic procedures (Allen and Gossling 1975; Miller and Blair 1985, pp. 266-316; Holub and Schnabl 1994, pp. 331-373). All methods try to solve the problem that row and column sums of an input-output table should correspond to the exogenous projection and negative inputs should be avoided.

14.2 Univariate methods

The basic idea of univariate methods to update input-output tables is to correct the matrix of input coefficients row-wise with a diagonal matrix of correction factors.

14.2.1 Proportional Correction Method

The matrix of projected input coefficients (A^p) is calculated by pre-multiplying row-wise the matrix of previous input coefficients (A) with a diagonal matrix of multipliers (R).

(1) $A^p = RA$

A^p = matrix of projected input coefficients
A = matrix of input coefficients in base year
R = diagonal matrix of multipliers for rows

This procedure is called the Proportional Correction Method (PCM). It was implemented for the first time by Matuszewski, Pitts and Sawyer (Matuszewski, Pitts and Sawyer 1964, pp. 233-254). An example of the Proportional Correction Method is elaborated in Box 14.1. As all input coefficients are corrected with the same factor in each row, it is assumed that substitution of a certain commodity affects all sectors in the same way. The share of intermediate output S_i in total output X_i is calculated for the base year as $s_i^t = S_i^t/X_i^t$ and the projected year as $s_i^k = S_i^k/X_i^k$. To identify the pure substitution effect, it is required to relate the coefficients to the same output level X^k. Therefore, the matrix of input coefficients for the base year is multiplied with the new output level to $a^t_{ij}X_j^k$ and then the corresponding artificial row totals S_i^{*t} are calculated including the corresponding shares $s_i^{*k} = S_i^{*k}/X_i^k$.

The diagonal matrix of correction factors R is determined by the relationship of the two shares as $r_i = s_i^{*}k/s_i^t$. To guarantee consistency of results the following input-output model is implemented:

(2) $x^p = (I - RA^k)^{-1}\, y^p$

x^p = vector of output in projection year p
I = unit matrix
R = diagonal matrix of correction factors reflecting relative change of intermediate shares in output
A^k = matrix of (estimated) input coeff. in projection year p
A^t = matrix of input coefficients in base year t
y^p = vector of final demand in projection year p.

Box 14.1: Proportional correction method

Table 1: Input-output table in year 0

Matrix A	Agricul. (1)	Industry (2)	Services (3)	Total (4)	Final d. (5)	Output (6)
Agriculture	20.00	34.00	10.00	64.00	36.00	100.00
Industry	20.00	152.00	40.00	212.00	188.00	400.00
Services	10.00	72.00	20.00	102.00	98.00	200.00
Total	50.00	258.00	70.00	378.00	322.00	700.00
Value added	50.00	142.00	130.00	322.00	0.00	322.00
Input	100.00	400.00	200.00	700.00	322.00	1022.00

Table 2: Input-output table in year 1

Matrix B	Agricul. (1)	Industry (2)	Services (3)	Total (4)	Final d. (5)	Output (6)
Agriculture	19.16	33.38	10.14	62.68	32.10	94.78
Industry	18.32	158.16	41.36	217.84	195.02	412.86
Services	9.80	76.48	22.08	108.36	104.32	212.68
Total	47.28	268.02	73.58	388.88	331.44	720.32
Value added	47.50	144.84	139.10	331.44	0.00	331.44
Input	94.78	412.86	212.68	720.32	331.44	1051.76

Table 3: Projection of output with old technology

Matrix C	Agricul. (1)	Industry (2)	Services (3)	Total (4)	Final d. (5)	Output (6)
Agriculture	18.96	35.09	10.63	64.68	30.10	94.78
Industry	18.96	156.89	42.54	218.38	194.48	412.86
Services	9.48	74.31	21.27	105.06	107.62	212.68
Total	47.39	266.29	74.44	388.12	332.20	720.32
Value added	47.39	146.57	138.24	332.20	-0.76	331.44
Input	94.78	412.86	212.68	720.32	331.44	1051.76

(4)/(6) C	(4)/(6) B	Correct. B/C
0.6825	0.6613	0.9690
0.5289	0.5276	0.9975
0.4940	0.5095	1.0314

$$\underbrace{\begin{bmatrix} 0.9690 & 0.0000 & 0.0000 \\ 0.0000 & 0.9975 & 0.0000 \\ 0.0000 & 0.0000 & 1.0314 \end{bmatrix}}_{R} * \underbrace{\begin{bmatrix} 0.2000 & 0.0850 & 0.0500 \\ 0.2000 & 0.3800 & 0.2000 \\ 0.1000 & 0.1800 & 0.1000 \end{bmatrix}}_{A} = \underbrace{\begin{bmatrix} 0.1938 & 0.0824 & 0.0485 \\ 0.1995 & 0.3791 & 0.1995 \\ 0.1031 & 0.1857 & 0.1031 \end{bmatrix}}_{A^k}$$

Table 4: Projection of input-output table

Matrix D	Agricul. (1)	Industry (2)	Services (3)	Total (4)	Final d. (5)	Output (6)
Agriculture	18.37	34.01	10.30	62.68	32.10	94.78
Industry	18.91	156.50	42.43	217.84	195.02	412.86
Services	9.78	76.65	21.94	108.36	104.32	212.68
Total	47.05	267.15	74.67	388.88	331.44	720.32
Value added	47.73	145.71	138.01	331.44	0.00	331.44
Input	94.78	412.86	212.68	720.32	331.44	1051.76

Table 5: Projected versus actual in percent

Matrix D	Agricul. (1)	Industry (2)	Services (3)	Total (4)	Final d. (5)	Output (6)
Agriculture	-4.1	1.9	1.6	0.0	0.0	0.0
Industry	3.2	0.0	2.6	0.0	0.0	0.0
Services	-0.2	0.2	0.0	0.0	0.0	0.0
Total	-0.5	-0.3	1.5	0.0	0.0	0.0
Value added	0.5	0.6	-0.8	0.0	0.0	0.0
Input	0.0	0.0	0.0	0.0	0.0	0.0

14.2.2 Statistical Correction Method

A more refined version of a similar methodology was developed by Tilanus (Tilanus 1968) under the name Statistical Correction Method (SCM). The main difference is that this time the diagonal matrix of correction factors refers to the difference between projected and actual output and not to the corresponding levels of intermediate demand.

(3) $x^p = R(I - A^t)^{-1} y^p$

x^p = vector of output in projection year p
I = unit matrix
R = diagonal matrix of correction factors reflecting relative change in output levels
A^t = matrix of input coefficients in base year t
y^p = vector of final demand in projection year p

14.3 Bivariate methods

In contrast to univariate methods, which work with corrections of rows only, bivariate models correct rows and columns of one input-output table at the same time. Early methods for updating input-output tables with bivariate methods were developed by Stone (Stone 1961), Stone and Brown (Stone and Brown 1962), Stone, Bates and Bacharach (Stone Bates and Bacharach 1963), and Bacharach (Bacharach 1970).

14.3.1 RAS procedure

The RAS procedure (RAS) was developed by Richard Stone and named after the typical sequence of matrices. This time the matrix of input coefficients (A) is pre-multiplied with a diagonal matrix of row factors of correction (R) and post-multiplied with a diagonal matrix of column factors of correction (S) in the following way:

(4) $A^p = RAS$

A^p = matrix of projected input coefficients
A = matrix of input coefficients in base year
R = diagonal matrix of multipliers for rows
S = diagonal matrix of multipliers for columns

Simple and modified RAS procedures are widely used to update input-output tables on the basis of a benchmark table that has been compiled with the help of census and survey data. The basic idea is to adjust in an iterative procedure the matrix for intermediate inputs column and row wise with appropriate multipliers until the given totals for intermediate input requirements are met. In the early development of the RAS procedure, Stone described the uniform change along any row as reflecting the substitution effect and down any column the fabrication effect.

The substitution effect refers to the substitution of one input for another. For example, to reflect the substitution of metal products by plastic products, all input coefficients in the row of plastics would increase (multiplied by 1.4) and all input coefficients in the row of metal products would decrease (multiplied by 0.8). The fabrication effect refers to the altered proportion of value added in a sectors total input. If the input coefficients in a column are reduced (multiplied by 0.8), the product of this industry embodies proportionately less intermediate inputs of other sectors and proportionately more of value added input (capital, labour, land).

At first sight the RAS procedure seems to have a sound economic basis with the capability to reflect technological change through the substitution and fabrication effects. However, many economists view the RAS procedure as a purely mathematical procedure hardly capable of tracing the complex phenomenon of technological change. It has been shown that the RAS technique emerges as a solution to a constrained optimisation problem in which, subject to new row and column totals, a new coefficient matrix A^p is generated which differs as little as possible from the previous observation in matrix A. In essence it is assumed that, in the absence of any new information, matrix A is still the best representation of inter-industry relationships. In Box 14.2 the RAS procedure is applied for a small numerical example.

Box 14.2: RAS procedure

Table 1: Input-output data for year 0

	Agricult.	Industry	Services	Total	Final d.	Output
Agriculture	20.00	34.00	10.00	64.00	36.00	100.00
Industry	20.00	152.00	40.00	212.00	188.00	400.00
Services	10.00	72.00	20.00	102.00	98.00	200.00
Total	50.00	258.00	70.00	378.00	322.00	700.00
Value added	50.00	142.00	130.00	322.00	0.00	322.00
Input	100.00	400.00	200.00	700.00	322.00	0.00

Table 2: Input-output data for year 1

	Agricult.	Industry	Services	Total	Final d.	Output
Agriculture	19.16	33.38	10.14	62.68	32.10	94.78
Industry	18.32	158.16	41.36	217.84	195.02	412.86
Services	9.80	76.48	22.08	108.36	104.32	212.68
Total	47.28	268.02	73.58	388.88	331.44	720.32
Value added	47.50	144.84	139.10	331.44	0.00	331.44
Input	94.78	412.86	212.68	720.32	331.44	0.00

ITERATION 1

Table 3: Calculation of row multipliers

	Agricult.	Industry	Services	Total		Actual	R
Agriculture	18.96	35.09	10.63	64.68		62.680	0.9690
Industry	18.96	156.89	42.54	218.38		217.840	0.9975
Services	9.48	74.31	21.27	105.06		108.360	1.0314

$$\underbrace{\begin{bmatrix} 0.9690 & 0.0000 & 0.0000 \\ 0.0000 & 0.9975 & 0.0000 \\ 0.0000 & 0.0000 & 1.0314 \end{bmatrix}}_{R1} * \underbrace{\begin{bmatrix} 0.2000 & 0.0850 & 0.0500 \\ 0.2000 & 0.3800 & 0.2000 \\ 0.1000 & 0.1800 & 0.1000 \end{bmatrix}}_{A} = \underbrace{\begin{bmatrix} 0.1938 & 0.0824 & 0.0485 \\ 0.1995 & 0.3791 & 0.1995 \\ 0.1031 & 0.1857 & 0.1031 \end{bmatrix}}_{A1}$$

Table 4: Calculation of column multipliers

	Agricult.	Industry	Services
Agriculture	18.37	34.01	10.30
Industry	18.91	156.50	42.43
Services	9.78	76.65	21.94
Total	47.05	267.15	74.67

Actual	47.28	268.02	73.58
S	1.0048	1.0032	0.9854

$$\underset{A1}{\begin{bmatrix} 0.1938 & 0.0824 & 0.0485 \\ 0.1995 & 0.3791 & 0.1995 \\ 0.1031 & 0.1857 & 0.1031 \end{bmatrix}} * \underset{S1}{\begin{bmatrix} 1.0048 & 0.0000 & 0.0000 \\ 0.0000 & 1.0032 & 0.0000 \\ 0.0000 & 0.0000 & 0.9854 \end{bmatrix}} = \underset{A2}{\begin{bmatrix} 0.1947 & 0.0826 & 0.0477 \\ 0.2005 & 0.3803 & 0.1966 \\ 0.1036 & 0.1863 & 0.1016 \end{bmatrix}}$$

Table 5: Input-output table with A2

	Agricult.	Industry	Services	Total	Final d.	Output
Agriculture	18.46	34.12	10.15	62.73	32.10	94.83
Industry	19.00	157.01	41.81	217.82	195.02	412.84
Services	9.82	76.90	21.62	108.33	104.32	212.65
Total	47.28	268.02	73.58	388.88	331.44	720.32
Value added	47.50	144.84	139.10	331.44	0.00	331.44
Input	94.78	412.86	212.68	720.32	331.44	0.00

ITERATION 2

Table 3: Calculation of row multipliers

	Agricult.	Industry	Services	Total		Actual	R
Agriculture	18.46	34.12	10.15	62.73		62.680	0.9992
Industry	19.00	157.01	41.81	217.82		217.840	1.0001
Services	9.82	76.90	21.62	108.33		108.360	1.0002

$$\underset{R1}{\begin{bmatrix} 0.9992 & 0.0000 & 0.0000 \\ 0.0000 & 1.0001 & 0.0000 \\ 0.0000 & 0.0000 & 1.0002 \end{bmatrix}} * \underset{A}{\begin{bmatrix} 0.1947 & 0.0826 & 0.0477 \\ 0.2005 & 0.3803 & 0.1966 \\ 0.1036 & 0.1863 & 0.1016 \end{bmatrix}} = \underset{A1}{\begin{bmatrix} 0.1946 & 0.0826 & 0.0477 \\ 0.2005 & 0.3803 & 0.1966 \\ 0.1037 & 0.1863 & 0.1017 \end{bmatrix}}$$

(continued)

Box 14.2: RAS procedure (continued)

Table 4: Calculation of column multipliers

	Agricult.	Industry	Services
Agriculture	18.44	34.09	10.15
Industry	19.00	157.02	41.82
Services	9.82	76.91	21.62
Total	47.27	268.03	73.58

Actual	47.28	268.02	73.58
S	1.0002	1.0000	1.0000

$$\underset{A1}{\begin{bmatrix} 0.1946 & 0.0826 & 0.0477 \\ 0.2005 & 0.3803 & 0.1966 \\ 0.1037 & 0.1863 & 0.1017 \end{bmatrix}} * \underset{S1}{\begin{bmatrix} 1.0002 & 0.0000 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 \\ 0.0000 & 0.0000 & 1.0000 \end{bmatrix}} = \underset{A2}{\begin{bmatrix} 0.1946 & 0.0826 & 0.0477 \\ 0.2005 & 0.3803 & 0.1966 \\ 0.1037 & 0.1863 & 0.1017 \end{bmatrix}}$$

Table 5: Input-output table with A2

	Agricult.	Industry	Services	Total	Final d.	Output
Agriculture	18.45	34.09	10.15	62.68	32.10	94.78
Industry	19.01	157.02	41.81	217.84	195.02	412.86
Services	9.83	76.91	21.62	108.36	104.32	212.68
Total	47.28	268.02	73.58	388.88	331.44	720.32
Value added	47.50	144.84	139.10	331.44	0.00	331.44
Input	94.78	412.86	212.68	720.32	331.44	0.00

ITERATION 3

Table 3: Calculation of row multipliers

	Agricult.	Industry	Services	Total		Actual	R
Agriculture	18.45	34.09	10.15	62.68		62.680	1.0000
Industry	19.01	157.02	41.81	217.84		217.840	1.0000
Services	9.83	76.91	21.62	108.36		108.360	1.0000

$$\underset{R1}{\begin{bmatrix} 1.0000 & 0.0000 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 \\ 0.0000 & 0.0000 & 1.0000 \end{bmatrix}} * \underset{A}{\begin{bmatrix} 0.1946 & 0.0826 & 0.0477 \\ 0.2005 & 0.3803 & 0.1966 \\ 0.1037 & 0.1863 & 0.1017 \end{bmatrix}} = \underset{A1}{\begin{bmatrix} 0.1946 & 0.0826 & 0.0477 \\ 0.2005 & 0.3803 & 0.1966 \\ 0.1037 & 0.1863 & 0.1017 \end{bmatrix}}$$

Table 4: Calculation of column multipliers

	Agricult.	Industry	Services
Agriculture	18.45	34.09	10.15
Industry	19.01	157.02	41.81
Services	9.83	76.91	21.62
Total	47.28	268.02	73.58

Actual	47.28	268.02	73.58
S	1.0000	1.0000	1.0000

R1		
0.1946	0.0826	0.0477
0.2005	0.3803	0.1966
0.1037	0.1863	0.1017

*

A		
1.0000	0.0000	0.0000
0.0000	1.0000	0.0000
0.0000	0.0000	1.0000

=

A1		
0.1946	0.0826	0.0477
0.2005	0.3803	0.1966
0.1037	0.1863	0.1017

FINAL RESULT

Table 5: Input-output table with A2

	Agricult.	Industry	Services	Total	Final d.	Output
Agriculture	18.45	34.09	10.15	62.68	32.10	94.78
Industry	19.01	157.02	41.81	217.84	195.02	412.86
Services	9.83	76.91	21.62	108.36	104.32	212.68
Total	47.28	268.02	73.58	388.88	331.44	720.32
Value added	47.50	144.84	139.10	331.44	0.00	331.44
Input	94.78	412.86	212.68	720.32	331.44	0.00

Table 6: Deviation of projected input-output table in percent

	Agricult.	Industry	Services	Total	Final d.	Output
Agriculture	-3.7	2.1	0.1	0.0	0.0	0.0
Industry	3.7	-0.7	1.1	0.0	0.0	0.0
Services	0.3	0.6	-2.1	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
Value added	0.0	0.0	0.0	0.0	-	0.0
Input	0.0	0.0	0.0	0.0	0.0	-

The RAS projection model is given by:

(5) $x^p = (I - RA^tS)^{-1}\, y^p$

x^p = vector of output in projection year p
I = unit matrix
R = diagonal matrix of correction factors for rows reflecting relative change of intermediate output
S = diagonal matrix of correction factors for columns reflecting relative change of intermediate input
A^t = matrix of input coefficients in base year t
y^p = vector of final demand in projection year p

The following attractive and less attractive properties of the RAS procedure should be noted:

- Signs are preserved (No positive input coefficient will be changed to a negative coefficient).
- Zero elements remain zero (New inputs or new products are neglected).
- Enforcement of consistency causes implausible change of some coefficients.

The simple RAS procedure will normally fail to produce an acceptable projection of an input-output table if structural change, change in relative prices and change in technology is substantial. However, the incorporation of other exogenous data in the modified RAS procedure will tend to improve the quality of the projection. Several variations of the RAS technique can be found in Allen and Gossling (Allen and Gossling 1975) and in Miller and Blair (Miller and Blair 1985, pp. 276-313). An evaluation of results for the RAS procedure is given in Box 14.3.

Box 14.3: Evaluation of results for RAS procedure

1. Mean absolute deviation (MAD) = (1/n^2)sum(!eij!)

!eij! =	0.0075	0.0017	0.0000
	0.0072	0.0028	0.0021
	0.0003	0.0010	0.0022

sum(!eij!) = 0.0249 MAD = 0.0028

MAD represents the average amount by which an estimated coefficient differs from the true coefficient.

2. Mean absolute percentage error (MAPE) = (1/n^2)sum(!pij!)

!pij! =	3.7	2.1	0.1
	3.7	0.7	1.1
	0.3	0.6	2.1

sum(!pij!) = 14.3942 MAPE = 1.5994

On average each coefficient will be 1.59 % larger or smaller than its true value.

3. Output multiplier

	ACTUAL			PROJECTED		
Input (A)	0.2022	0.0809	0.0477	0.1946	0.0826	0.0477
	0.1933	0.3831	0.1945	0.2005	0.3803	0.1966
	0.1034	0.1852	0.1038	0.1037	0.1863	0.1017
Leontief (I-A)	0.7978	-0.0809	-0.0477	0.8054	-0.0826	-0.0477
	-0.1933	0.6169	-0.1945	-0.2005	0.6197	-0.1966
	-0.1034	-0.1852	0.8962	-0.1037	-0.1863	0.8983
Inverse (I-A)-1	1.3185	0.2074	0.1151	1.3085	0.2090	0.1152
	0.4932	1.8115	0.4193	0.5046	1.8080	0.4225
	0.2541	0.3984	1.2158	0.2557	0.3990	1.2141
Column sum	2.0658	2.4173	1.7503	2.0687	2.4160	1.7518
Percentage errors in output multipliers (in %)				0.1	-0.1	0.1

4. Impact on output

	$(I-A)^{-1}$			Y	X
ACTUAL	1.3185	0.2074	0.1151	32.10	94.78
	0.4932	1.8115	0.4193	195.02	412.86
	0.2541	0.3984	1.2158	104.32	212.68

	$(I-A)^{-1}$			Y	X
PROJECTED	1.3085	0.2090	0.1152	32.10	94.78
	0.5046	1.8080	0.4225	195.02	412.86
	0.2557	0.3990	1.2141	104.32	212.68

	$(I-A)^{-1}$			Y	X
Change in %	-0.8	0.8	0.1	0.0	0.0
	2.3	-0.2	0.7	0.0	0.0
	0.6	0.2	-0.1	0.0	0.0

The effect on the gross output of sector 3 is underestimated by 1.5 percent, if final demand components grow at different rates (A +20 %, B +30 %, C 40 %).

	(I-A)$^{-1}$			Y	X
ACTUAL	1.3185	0.2074	0.1151	211.20	338.36
	0.4932	1.8115	0.4193	192.40	525.50
	0.2541	0.3984	1.2158	173.60	341.37
	(I-A)$^{-1}$			Y	X
PROJECTED	1.3085	0.2090	0.1152	211.20	336.57
	0.5046	1.8080	0.4225	192.40	527.76
	0.2557	0.3990	1.2141	173.60	341.53
	(I-A)$^{-1}$			Y	X
Change in %	-0.8	0.8	0.1	0.0	-0.5
	2.3	-0.2	0.7	0.0	0.4
	0.6	0.2	-0.1	0.0	0.0

14.3.2 Model of Double Proportional Patterns

The Model of Double Proportional Patterns (MODOP) was developed by Stäglin (Stäglin 1972. pp. 69-81). In a first step, all missing transactions are estimated resulting in inconsistent row and column totals. Therefore, a RAS procedure is used in a second step to guarantee the consistency of results concerning supply and demand. It can be shown that this procedure produces under certain conditions the same results as a pure RAS procedure. The basic idea is to calculate the geometric mean of row and column multipliers and then apply this factor to each element of the matrix.

(6) $x^p = (I - MA^t)^{-1} y^p$

x^p = vector of output in projection year p
I = unit matrix
M = matrix of correction factors for geometric mean of relative change of intermediate input and output
A^t = matrix of input coefficients in base year t
y^p = vector of final demand in projection year p.

14.3.3 Procedure of Selected Coefficients

The Procedure of Selected Coefficients (PSC) was developed by Ehret (Ehret 1970, Evers 1974). The procedure can be regarded as a further development of the Proportional Correction Method (PCC). In this procedure it is assumed that the substitution of intermediates in production is not uniform but different in each sector. The diagonal matrix of multipliers R is multiplied with a matrix of correction factors. As the matrix H corrects rows and columns, this procedure belongs to the family of bivariate procedures.

(7) H = RG

H = Matrix of correction factors
R = Diagonal matrix of row multipliers
G = Matrix of sectoral correction factors

In this case the projection model is defined as:

(8) $x^p = (I - HA^t)^{-1} y^p$

x^p = vector of output in projection year p
I = unit matrix
H = matrix of sectoral correction factors
A^t = matrix of input coefficients in base year t
y^p = vector of final demand in projection year p.

14.4 Stochastic procedures

Stochastic procedures assume that many independent variables may influence changes of input coefficients. The changing coefficients do not follow homogenous row and column multipliers, but rather the complex features of stochastic elements.

14.4.1 Lagrange method

Matrices in which the row and column sums are known quite accurately but for which the information about the content is incomplete are common in applied input-output analysis. The consequence is a matrix in which the row and column sums do not correspond with the information about these sums. Such a table is inconsistent.

In practice inconsistent tables are usually adjusted to the desired sums with the aid of the popular RAS method. As it has been demonstrated in the previous chapter, the RAS method multiplies the rows and columns in an iterative process by certain factors. Harthoorn and von Dalen (Harthoorn and van Dalen 1987) have developed a theoretically more elegant method of adjustment with the aid of Lagrange multipliers. In this method, the rows and columns are multiplied by factors in such a way that the deviation from the original elements is kept to a minimum. Furthermore, the confidence with which the values of the elements are determined can also be taken into account. In practice, this method is presently used by the Central Statistical Office of the Netherlands (CBS). It is surprising that this method is not applied more widely.

The reasons behind the specific preference for the RAS method are:

- It is well established and easy to programme.
- It requires less computer compilation time.
- It takes up less space in the computers' central memory.
- In many cases the results of the two methods turn out to be more or less comparable.

Harthoorn and van Dalen demonstrated that the calculation time which is required for Lagrange multipliers can be drastically reduced if the system is partitioned and subsequently transformed into a symmetrical system of equations.

The Lagrange method is applied in a situation with a matrix with elements a_{ij}, a column vector r with desired row sums r_i and a row vector c' with desired column sums c_j. The following then applies:

Minimise

(9) $$\sum_{j=1}^{m} a_{kj} = r_k$$

(10) $$\sum_{i=1}^{n} a_{il} = c_l$$

In practice, this requirement is often not fulfilled.

Let us assume that the relative confidences of elements a_{ij} are known and represented by g_{ij}. We now look for factors f_{ij} so that

(11) $$\sum_{i=1}^{n} \sum_{j=1}^{m} (f_{ij}\, a_{ij} - a_{ij})^2 / g_{ij} = \min.$$

(12) $$\sum_{i=1}^{n} f_{il}\, a_{il} = c_l$$

(13) $$\sum_{j=1}^{m} f_{kj}\, a_{kj} = r_k$$

Equation (11) can also be written as

$$(14)\quad \sum_{i=1}^{n} \sum_{j=1}^{m} (f_{ij} - 1_j)^2 a_{ij}^{\,2} / g_{ij} = \min.$$

The constraints (11), (12) and (13) can be summed up in the minimisation of the Lagrange function L:

$$(15)\ L = (1/2) \sum_{i=1}^{n} \sum_{j=1}^{m} (f_{ij} - 1_j)^2 a_{ij}^{\,2} / g_{ij} + \sum_{i=1}^{n} \lambda_i (r_i - \sum_{j=1}^{m} f_{ij}\ a_{ij}) + \sum_{j=1}^{m} \mu_j (c_j - \sum_{i=1}^{n} f_{ij}\ a_{ij}) = \min.$$

The partial derivatives of the Lagrange function with respect to λ_k and μ_l lead to equations (12) and (13) respectively. The partial derivative with respect to the unknown factor f_{kl} results in

$$(16)\ \partial L/\partial f_{kl} = (f_{kl} - 1) a_{kl}^{\,2} / g_{kl} - \lambda_k a_{kl} - \mu_l a_{kl} = 0$$

Therefore

$$(17)\ (\lambda_k + \mu_l)\ g_{kl} = (f_{kl} - 1)\ a_{kl}$$

from which it follows that

$$(18)\quad \sum_{j=1}^{m} (\lambda_k + \mu_j) g_{kj} = \sum_{j=1}^{m} (f_{kj} - 1) a_{kj} = \sum_{j=1}^{m} f\lambda_{kj}\ a_{kj} - \sum_{j=1}^{m} a_{kj} = r_k - \sum_{j=1}^{m} a_{kj} = s_k$$

where s_k is defined as the difference between the existing and the desired sum of the elements of the row k. Similarly, we find

$$(19)\quad \sum_{i=1}^{n} (\lambda_i + \mu_j) g_{il} = c_l - \sum_{i=1}^{n} a_{il} = d_l$$

where d_l is the difference from the desired column sum.

The system in (18) and (19) is the classic form in which the Lagrange multipliers are sought to be calculated. Once they have been calculated, they are substituted in (17), and the desired consistent matrix can subsequently be determined with the aid of factors f_{ij}.

For the adjustment of two-dimensional tables, the authors recommend the application of the Lagrange method rather than the widely used RAS method. Besides the advantage of taking into account the confidence intervals of individual elements, the Lagrange method is more efficient in reducing requirements for the computer capacity.

14.4.2 Least Squares Method

The objective of the Least Squares Method (LSM) (Jaksch and Conrad 1971, pp. 131-138) is to minimise the difference between actual values X^t_{ij} and projected (corrected) values X^k_{ij} under the constraints of given row and column totals for intermediates. To avoid that elements which are zero in matrix A^t become non-zero in the projected matrix A^k, the correction factor g_{ij} is introduced with value 1 for $x^t_{ij} > 1$ and with value 0 for $x^t_{ij} = 0$.

Minimise

$$(20)\quad K = \sum_{ij} g_{ij}(X^k_{ij} - X^t_{ij})^2$$

under the constraints

$$(21)\ N_i = \sum_i \alpha_i \sum_j (X^k_{ij} - S^k_i)$$

$$(22)\ N_i = \sum_j \beta_j \sum_i (X^k_{ij} - U^k_j)$$

α = Lagrange multiplier for rows
β = Lagrange multiplier for columns
g = correction factor
X_{ij} = intermediates
S_i = row total for intermediates
U_j = column total for intermediates

The projection model of the Least Square Method is defined as:

$$(23)\ x^p = (I - A^k)^{-1}\ y^p$$

x^p = vector of output in projection year p
I = unit matrix
A^k = matrix of corrected input coefficients
y^p = vector of final demand in projection year p

It can be shown that the Least Square Method converges under certain conditions with the results of a bivariate model (e.g. RAS Procedure).

14.4.3 Minimisation approach

Kuroda (Kuroda 1988) developed a method for constructing consistent input-output data sets. The method can be used to resolve inconsistencies between input-output data from various sources. It belongs to the class of algorithms discussed by Bacharach and has been extensively used by Kuroda and Wilcoxen (Wilcoxen 1988).

In input-output analysis it is often necessary to use inconsistent data sets originating from different government agencies. For example, the table of inter-industry transactions created by one agency may not be consistent with value added and final demand vectors produced elsewhere. In this case, the investigator will be confronted with three pieces of data which are not compatible: a table of inter-industry transactions, a vector of commodity outputs, and a vector of gross output by industry. The task then is to adjust the transactions table to match the commodity and industry output vectors.

In the past, this problem was solved by using the RAS method. It has been discussed that RAS is an interactive algorithm which scales the rows and columns of the transactions table up and down repeatedly until the table's row and column sums agree with the target vectors. It has been shown that RAS will eventually converge, but the result will not necessarily be close in any economic sense to the original transactions table. The purpose of Kuroda's method is to define a measure of how far a new transactions table is from the original, and to derive an algorithm which will construct a table minimising that distance.

Given an n x m matrix X^0 of initial data, define r_{ij} and c_{ij} to be the shares of each element in the row and column sums of the original matrix:

$$(24)\ r_{ij} = X_{ij}^0 / \sum_{j=1}^{m} X_{ij}^0$$

$$(25)\ c_{ij} = X_{ij}^0 / \sum_{i=1}^{n} X_{ij}^0$$

Let R be a vector of target row totals, and C a vector of desired column totals. The following function can then be used to measure the distance between a revised matrix X and the original, where w and v are arbitrary sets of weights:

$$(26)\ Q = (1/2) \sum_{i=1}^{n} \sum_{j=1}^{m} [(X_{ij}/R_i)-r_{ij}]^2 w_{ij} + (1/2) \sum_{i=1}^{n} \sum_{j=1}^{m} [(X_{ij}/C_j)-c_{ij}]^2 v_{ij}$$

It is now possible to choose X to minimise this function subject to the following constraints:

$$(27)\ R_i = \sum_{j=1}^{m} X_{ij}$$

$$(28)\ C_j = \sum_{i=1}^{n} X_{ij}$$

The Lagrange function for this problem is:

$$(29)\ Q = (1/2) \sum_{i=1}^{n} \sum_{j=1}^{m} [(X_{ij}/R_i)-r_{ij}]^2 w_{ij} + (1/2) \sum_{i=1}^{n} \sum_{j=1}^{m} [(X_{ij}/C_j)-c_{ij}]^2 v_{ij}$$

$$+ \sum_{i=1}^{n} \lambda_i (R_i - \sum_{j=1}^{m} X_{ij}) + \sum_{j=1}^{m} \mu_j (C_j - \sum_{i=1}^{n} X_{ij})$$

14.4.4 Euro method

In recent years, some countries have considerably reduced the time lag for the publication of input-output tables. However, the problem remains that many applications of input-output analysis are obsolete because the data base is outdated. It is costly to establish harmonised input-output tables for the European Community, as it relies to a great extent on surveys and primary statistics. Therefore, the submission programme for ESA 1995 requests a sequence of five-yearly input-output tables which complements the series of annual supply and use tables. As supplement for the years in-between, but also to cover the time lag between the last input-output table and the latest set of national accounts, Eurostat will update input-output tables based on a new methodology. The new updating procedure for input-output tables avoids arbitrary changes of important input coefficients, which sometimes occur if traditional RAS procedures are applied.

The following assumptions form the basis of the new update procedure: Substitution processes change inputs (rows), production effects influence outputs (columns) and price effects affect inputs and outputs. The new update method EURO avoids the shortcomings of projection methods like RAS, MODOP, Linear Programming Method or the Statistical Correction Method. All these methods have been the cause of theoretical dispute and practical problems. This new update procedure has been developed by Beutel (Beutel 2002, Beutel et al. 1994, Penzkofer, Schmalholz, Scholz and Beutel 1989) for Eurostat.

EURO corresponds to the basic idea of the RAS approach. However, it encompasses all the elements of an input-output table and, consequently, all quadrants of an input-output table in an activity analysis approach. In this interpretation, the columns of the input-output table represent basic activities which are treated on an equal basis. The new update method only uses official macroeconomic forecasts as exogenous input for the iterative procedure. Column and row vectors for intermediate consumption and final demand are derived as endogenous variables, rather than accepted as exogenous variables from unspecified sources.

With this methodology, a new procedure to update and project input-output tables on the basis of macroeconomic forecasts has been implemented in empirical research. The basic idea of the approach is to derive input-output tables, which are consistent with official macroeconomic forecasts for GDP but avoid arbitrary adjustments of input coefficients to ensure the consistency of supply and demand. Very few – if any – official macroeconomic forecasts refer to projections of intermediate consumption. In most cases, the projection of gross domestic product includes a forecast for GDP and the various categories of final demand and in some cases for selected sectoral growth rates of value added.

The starting point of the iteration procedure is an input-output table of a base year comprised of six quadrants for domestic production, imports and value added. The required database is presented in Table 14.1. For the Euro method we assume that a projection for GDP, imports, the various components of final demand and the value added of branches (see shaded elements in Figure 14.1) is available. With the following procedure, real growth rates for domestic output (activity levels) and imports of goods and services are derived, which are consistent with the official macroeconomic forecast of the Commission.

The iteration procedure starts with the assumption that, in the first iteration, the given growth rates for value added will be used to define a starting point for the unknown growth rates characterising the activity levels of output sectors and input sectors. Later on, these growth rates will be revised in an iterative procedure until the projected exogenous macroeconomic variables are reproduced. The growth rates for domestic input and output correspond during the process of iteration, while the growth rates for imported commodities drift away from the corresponding growth rates for domestic commodities, until the projected level of total imports is reproduced. The same is true for the growth rates of value added and output by sector. There is no convincing reason why value added and output should grow at the same rate. With the globalisation of economic activities, intermediates grew more rapidly than value added during the last decade.

Table 14.1: Projection of input-output tables

		Input of production activities				Final use of goods and services					Output (1-36)
		Agricul-ture	Energy	Industry	Services	Private con-sump-tion	Govern-ment con-sumption	Gross fixed capital formation	Change in inven-tories	Exports	
		1	:	:	30	31	32	33	34	35	36
Agriculture	1										Domestic production
Energy	:										
Industry	:										
Services	30										
Total (1-30)	31										Total output
Agriculture	32										Imports
Energy	:										
Industry	:										
Services	61										
Total (32-61)	62										Total imports
Compensation of employees	63										Value added
Net taxes on production	64										
Consumption of fixed capital	65										
Net operating surplus	66										
Value added (63-66)	67	Value added									Total value added
Input (31+62+67)	78	Domestic production				Final demand					

= Forecast of real growth rates for final demand components

= Forecast of real growth rates for value added by branch

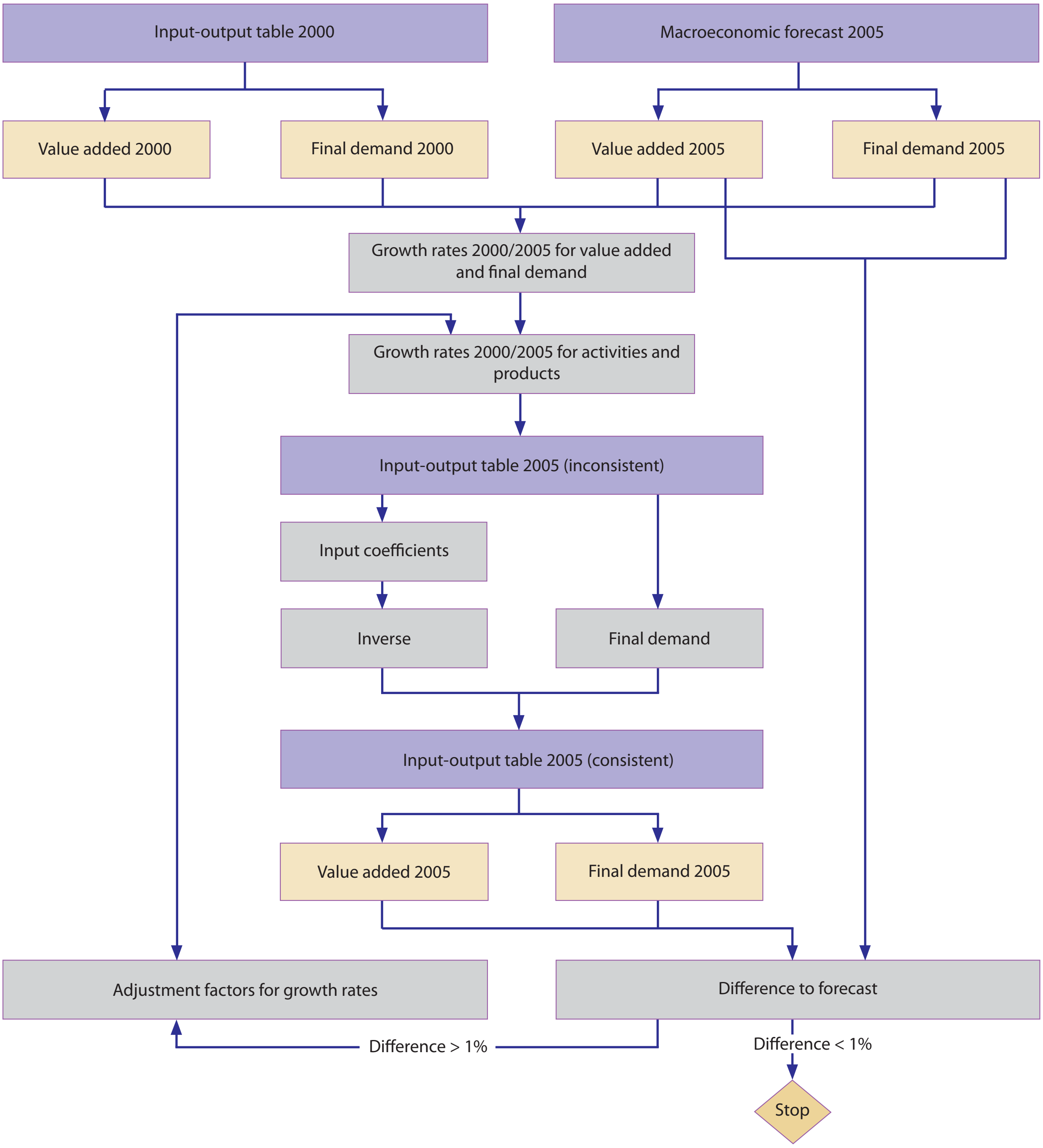
Each element of all six quadrants is weighted in an iterative procedure with the growth rates for the activity levels of the corresponding input and output sector. After the process of weighting the transactions, it cannot be expected that the resulting input-output table will be consistent. Therefore, a traditional input-output model with projected final demand and new technology is solved to guarantee the consistency of the system in terms of supply and demand. In a second step, a consistent input-output table is calculated by applying the quantity model of input-output analysis.

In a third step, the projected real growth rates for value added and final demand components are compared with the macroeconomic forecast. If deviations are observed, growth rates for input and output levels of the corresponding sectors are marginally changed for the next iteration. It must be noted that sectoral growth rates for value added and output of a sector only correspond in the first iteration and then deviate.

The general approach of the Euro method is presented in the flow chart of Figure 14.1. The projection is completed if the model results correspond to the projected macroeconomic variables at a margin of one percent deviation or less. In contrast to the RAS procedure, this method guarantees that innovative sectors gain in relative importance in all activities, while declining sectors lose in importance everywhere. Consequently, irrational changes of individual coefficients against the trend of technology and market forces are avoided which are observed when the RAS procedure with given row and column totals is applied. Innovation, technological trends and market forces and not the enforcement of consistency have priority in the new update procedure.

The Euro method has some familiarity with a price model in which a unit multiplication of rows with prices indexes would reflect the growth of primary inputs. However, Euro reflects also the substitution which is induced by the change of relative prices. The optimal allocation of input and output in an input-output table requires that for all inputs the relative marginal products equal the relative factor prices and that the marginal products equal the real factor prices respectively marginal costs equal product prices.

Figure 14.1: Projection of input-output tables



As the Euro method uses scale factors for rows and columns of the input-output table to derive the unknown growth rates for output from the projected sectoral growth rates for value added, the Euro approach has some correspondence to the procedure of Almon (Almon 2000) to estimate product-to-product input-output tables with no negative flows from supply and use tables by applying the product-technology assumption.

However, the Euro method to project input-output tables is no substitute for the task of compiling original input-output tables which rely to a great extent on primary sources and survey results. Euro is a valuable instrument to project input-output structures for specific purposes at low cost and it will help to reduce the undue time lag of official input-output tables. As soon as the official input-output tables are available, the Eurostat projections can be withdrawn.

A basic feature of the new methodology is the fact that all economic activities are equally treated in this approach. From an activity point of view, an input-output table encompasses all economic activities represented by the various columns in the table. In modern times, private households are more interested in generating certain consumption activities (food, housing, leisure, culture, health, education etc.) than in purchasing certain quantities of goods and services. Consequently, private consumption activities and other final demand activities are treated like production activities in the projection of input-output tables. The essential feature of the methodology is to project unknown sectoral growth rates for all activity levels including final demand activities which correspond to the official macroeconomic forecast.

Step 1: Updating intermediate and final inputs

For the update, all transactions of quadrants I to IV are weighted with the arithmetic mean of the corresponding output growth rates (z) and input growth rates (s).

(33) $T_2 = Z * T_1$
(34) $T_3 = T_1 * S$
(35) $T_4 = (T_2 + T_3)/2$ Arithmetic mean

respectively

(36) $T_4 = \mathrm{sqrt}(T_1 \# T_2)$ Geometric mean

T_1 = matrix of intermediate consumption and final demand of goods and services (r x p)
T_2 = matrix of weighted transactions with growth rates of commodity output (r x p)
T_3 = matrix of weighted transactions with growth rates of activities (r x p)
T_4 = matrix of weighted transactions for quadrants I to IV (r x p)
Z = diagonal matrix of output growth rates of domestic output and imports by commodity (r x r)
S = diagonal matrix of input growth rates of production and final demand activities (p x p)
r = number of domestic and imported commodities
p = number of activities (production and final demand)

Step 2: Updating value added by sector

Value added by sector is updated by multiplying value added of the base year with the diagonal matrix of input growth rates (wi).

(37) $T_5 = v * wi$

T_5 = row vector of weighted transactions for value added with growth rates of input sectors (1 x p)
v = vector of value added by sector (1 x p)

Step 3: Aggregating input-output table A

A first approximation of the updated input-output table is established through horizontal concatenation. Input and output levels are still inconsistent after step 3. The result is called input-output table A.

Step 4: Calculating input coefficients for input-output table

In step 4, it is assumed that the new technology is represented by the input structure of input-output table A. The complete set of input coefficients is calculated for domestic products, imports and value added.

(38) $a_{ij} = x_{ij}/x_{.j}$
(39) $b_{ij} = m_{ij}/x.j$
(40) $c_{.j} = v_{.j}/x_{.j}$

a_{ij} = input coefficients for domestic goods and services
b_{ij} = input coefficients for imported goods and services
$c_{.j}$ = input coefficients for value added
x_{ij} = intermediate consumption of domestic goods and services
m_{ij} = intermediate consumption of imported goods and services
$v_{.j}$ = value added
$x_{.j}$ = domestic production

Step 5: Creating input-output model

Based on the input coefficients of step 4, the inverse is calculated and then multiplied with the vector of final demand which was derived from input-output table A.

(41) $x = (I-A)^{-1}y$

X = column vector of output (domestic production)
A = matrix of input coefficients aij
I = unit matrix
$(I-A)^{-1}$ = matrix of cumulative input coefficients (inverse)
y = column vector of final demand

Step 6: Determining input requirements

The input requirements are calculated to determine the transaction for the balanced input-output table, which will be aggregated in the next step.

(42) $Z = B^*(I-A)^{-1}y$

B = matrix of input coefficients for domestic intermediates, imported intermediates and value added
Z = matrix of input requirements

Step 7: Aggregating input-output table

The consistent input-output table B is established through vertical concatenation. However, the levels for value added and final demand components do not correspond to the exogenous projection. Therefore, the following iteration is started.

Step 8: Iterating

Growth rates for output (wo) and input (wi) are marginally changed during the iteration until the projected growth rates for value added and final demand in input-output table B correspond with the given projection. The higher the number of iterations (k), the better the projected variables will be reproduced. The growth rates are adjusted in k iterations until the projected values for final demand and value are reproduced at a 1 % error margin.

The deviation between projected macroeconomic variables and model results is defined as:

(43) dev = pro/mod

dev = deviation
pro = exogenous projection of macroeconomic variables
mod = input-output projection (model result)

The observed deviations can directly be used to correct the growth rates z and s in an additive procedure. In this case, the multipliers and the adjustment functions of type A are defined as:

For dev > 0

(44) MULT = DEV - I
(45) Z = Z + MULT
(46) S = S + MULT

For dev <0

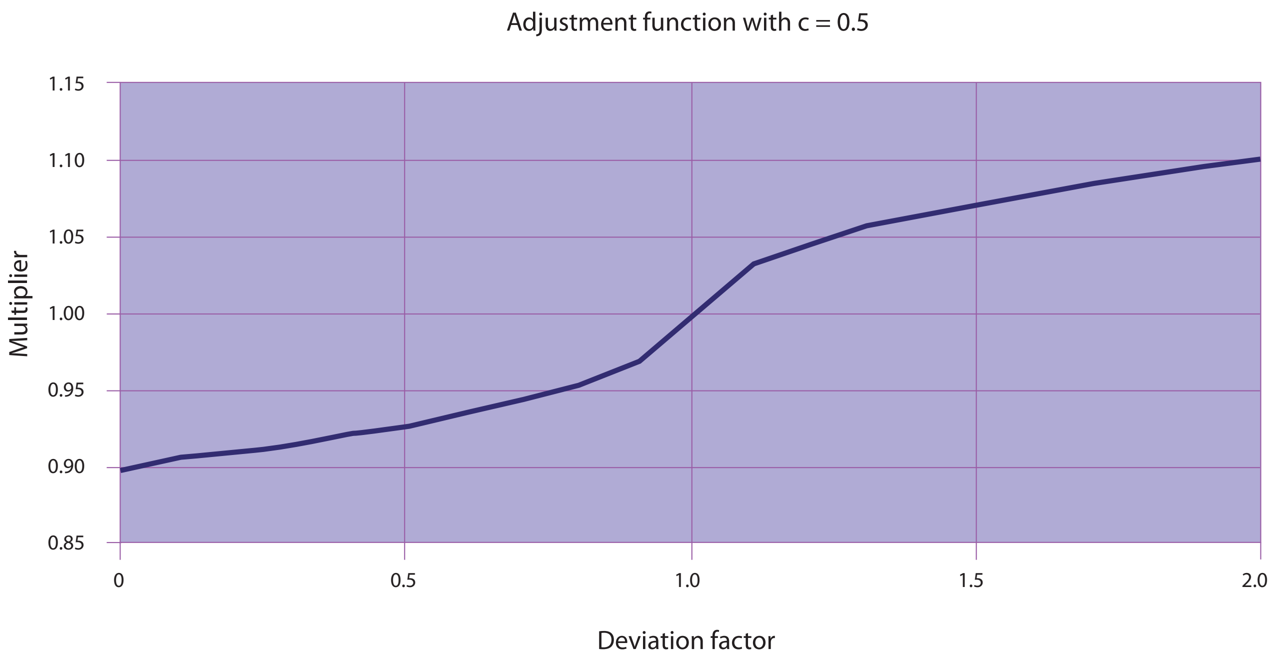
(47) MULT = I - DEV
(48) Z = Z - MULT
(49) S = Z - MULT

MULT = diagonal matrix of adjustment multipliers for growth rates
DEV = diagonal matrix of deviation factors
I = unit matrix
Z = diagonal matrix of growth rates for domestic and imported commodities
S = diagonal matrix of growth rates for production and final demand activities

The adjustment functions A are efficient in finding a solution without too many iterations but cyclical fluctuations can lead to instability of the system.

A convex adjustment function of type B can be recommended to adjust the growth rates during the iteration in a more careful procedure. If the model underestimates (overestimates) the projected macroeconomic variables, the corresponding growth rates wo and wi respectively are increased (decreased) according to the convex adjustment function. The adjustment elasticity in the graph in Figure 14.2 was set at c=0.5.

Figure 14.2: Adjustment function



The function is defined as:

For dev > 0

(50) mult = 1 + [(dev-1)100]c/100 for dev > 0
(51) wo = wo * mult
(52) wi = wi * mult

For dev < 0

(53) mult = 1 - [(1-dev)100]c/100 for dev < 0
(54) wo = wo * mult
(55) wi = wi * mult

c = adjustment elasticity

Box 14.4: Euro method

Table 1: Input-output tables

	Euro	Agric 1	Indust 2	Servic 3	Consu 4	Export 5	Output 6
	IOT BASE YEAR						
1	Agriculture	16.00	28.00	6.00	15.00	35.00	100.00
2	Industry	12.00	144.00	24.00	90.00	130.00	400.00
3	Services	9.00	64.00	16.00	45.00	66.00	200.00
4	Agr imported	4.00	6.00	4.00	15.00	0.00	29.00
5	Ind imported	8.00	8.00	16.00	90.00	0.00	122.00
6	Ser imported	1.00	8.00	4.00	45.00	0.00	58.00
7	Value added	50.00	142.00	130.00	0.00	0.00	322.00
8	Input	100.00	400.00	200.00	300.00	231.00	1231.00
	IOT PROJECTION						
1	Agriculture	15.36	27.44	6.06	14.70	31.22	94.78
2	Industry	11.04	149.76	24.72	92.70	134.64	412.86
3	Services	8.82	67.84	17.60	49.50	68.92	212.68
4	Agr imported	3.80	5.94	4.08	14.85	0.00	28.67
5	Ind imported	7.28	8.40	16.64	93.60	0.00	125.92
6	Ser imported	0.98	8.64	4.48	50.40	0.00	64.50
7	Value added	47.50	144.84	139.10	0.00	0.00	331.44
8	Input	94.78	412.86	212.68	315.75	234.78	1270.85
	GROWTH RATES						
1	Agriculture	-4.0	-2.0	1.0	-2.0	-10.8	-5.2
2	Industry	-8.0	4.0	3.0	3.0	3.6	3.2
3	Services	-2.0	6.0	10.0	10.0	4.4	6.3
4	Agr imported	-5.0	-1.0	2.0	-1.0	-	-1.1
5	Ind imported	-9.0	5.0	4.0	4.0	-	3.2
6	Ser imported	-2.0	8.0	12.0	12.0	-	11.2
7	Value added	-5.0	2.0	7.0	-	-	2.9
8	Input	-5.2	3.2	6.3	5.3	1.6	3.2

Table 2: Growth rates for value added and final demand

	Euro	Agric 1	Indust 2	Servic 3	Cons 4	Export 5	Value a 6	Import 7
1	Growth	0.9500	1.0200	1.0700	1.0525	1.0164	1.0293	1.0483

FIRST ITERATION

Row multipliers for inputs

0.9500	0	0	0	0	0	0
0	1.0200	0	0	0	0	0
0	0	1.0700	0	0	0	0
0	0	0	0.9500	0	0	0
0	0	0	0	1.0200	0	0
0	0	0	0	0	1.0700	0
0	0	0	0	0	0	1.0293

Input-output table

16.00	28.00	6.00	15.00	35.00
12.00	144.00	24.00	90.00	130.00
9.00	64.00	16.00	45.00	66.00
4.00	6.00	4.00	15.00	0.00
8.00	8.00	16.00	90.00	0.00
1.00	8.00	4.00	45.00	0.00
50.00	142.00	130.00	0.00	0.00

Input-output matrix weighted with row multipliers

15.20	26.60	5.70	14.25	33.25
12.24	146.88	24.48	91.80	132.60
9.63	68.48	17.12	48.15	70.62
3.80	5.70	3.80	14.25	0.00
8.16	8.16	16.32	91.80	0.00
1.07	8.56	4.28	48.15	0.00
51.47	146.16	133.81	0.00	0.00

Matrix T2 = WO * T1

Input-output table

16.00	28.00	6.00	15.00	35.00
12.00	144.00	24.00	90.00	130.00
9.00	64.00	16.00	45.00	66.00
4.00	6.00	4.00	15.00	0.00
8.00	8.00	16.00	90.00	0.00
1.00	8.00	4.00	45.00	0.00
50.00	142.00	130.00	0.00	0.00

Column multipliers for outputs

0.9500	0	0	0	0
0	1.0200	0	0	0
0	0	1.0700	0	0
0	0	0	1.0525	0
0	0	0	0	1.0164

Input-output matrix weighted with column multipliers

15.20	28.56	6.42	15.79	35.57
11.40	146.88	25.68	94.73	132.13
8.55	65.28	17.12	47.36	67.08
3.80	6.12	4.28	15.79	0.00
7.60	8.16	17.12	94.73	0.00
0.95	8.16	4.28	47.36	0.00
47.50	144.84	139.10	0.00	0.00

Matrix T3 = T1 * WI

Arithmetic mean of T2 and T3

15.20	27.58	6.06	15.02	34.41
11.82	146.88	25.08	93.26	132.36
9.09	66.88	17.12	47.76	68.85
3.80	5.91	4.04	15.02	0.00
7.88	8.16	16.72	93.26	0.00
1.01	8.36	4.28	47.76	0.00
49.48	145.50	136.46	0.00	0.00

Matrix T4 = (T2 + T3)/2

Table 3: Inconsistent input-output table

	Euro	Agric 1	Indust 2	Servic 3	Consu 4	Export 5	Output 6
1	Agriculture	15.20	27.58	6.06	15.02	34.41	98.27
2	Industry	11.82	146.88	25.08	93.26	132.36	409.41
3	Services	9.09	66.88	17.12	47.76	68.85	209.70
4	Agr imported	3.80	5.91	4.04	15.02	0.00	28.77
5	Ind imported	7.88	8.16	16.72	93.26	0.00	126.02
6	Ser imported	1.01	8.36	4.28	47.76	0.00	61.41
7	Value added	47.50	144.84	139.10	0.00	0.00	331.44
8	Input	96.30	408.61	212.40	312.08	235.63	1265.01

Table 4: Input coefficients

		Agric 1	Indust 2	Servic 3	Consu 4	Export 5
1	Agriculture	0.1578	0.0675	0.0285	0.0481	0.1460
2	Industry	0.1227	0.3595	0.1181	0.2988	0.5618
3	Services	0.0944	0.1637	0.0806	0.1530	0.2922
4	Agr imported	0.0395	0.0145	0.0190	0.0481	0.0000
5	Ind imported	0.0818	0.0200	0.0787	0.2988	0.0000
6	Ser imported	0.0105	0.0205	0.0202	0.1530	0.0000
7	Value added	0.4933	0.3545	0.6549	0.0000	0.0000
8	Input	1.0000	1.0000	1.0000	1.0000	1.0000

Table 5: Leontief matrix and inverse

		Agric 1	Indust 2	Servic 3
	Leontief matrix			
1	Agriculture	0.842	-0.067	-0.029
2	Industry	-0.123	0.641	-0.118
3	Services	-0.094	-0.164	0.919
	Inverse			
1	Agriculture	1.2144	0.1423	0.0560
2	Industry	0.2644	1.6451	0.2195
3	Services	0.1717	0.3075	1.1325

Table 6: Input-output model

		Agric 1	Indust 2	Servic 3	Final 2	Output 3
		(I-a)-1			y	x
1	Agriculture	1.2144	0.1423	0.0560	49.43	98.65
2	Industry	0.2644	1.6451	0.2195	225.63	409.85
3	Services	0.1717	0.3075	1.1325	116.61	209.92

Table 7: Consistent input-output table

	Euro	Agric 1	Indust 2	Servic 3	Consu 4	Export 5	Output 6
1	Agriculture	15.57	27.66	5.99	15.02	34.41	98.65
2	Industry	12.11	147.32	24.79	93.26	132.36	409.85
3	Services	9.31	67.08	16.92	47.76	68.85	209.92
4	Agr imported	3.89	5.93	3.99	15.02	0.00	28.83
5	Ind imported	8.07	8.18	16.52	93.26	0.00	126.04
6	Ser imported	1.03	8.39	4.23	47.76	0.00	61.41
7	Value added	48.66	145.28	137.48	0.00	0.00	331.42
8	Input	98.65	409.85	209.92	312.08	235.63	1266.12

Table 8: Actual versus projected growth rates of macroeconomic variables

		Value added agricul 1	Value added Indust 2	Value added servic 3	Con-sump-tion 4	Export 5	Total value added 6	Import 7
1	Actual	0.9500	1.0200	1.0700	1.0525	1.0164	1.0293	1.0483
2	Project	0.9732	1.0231	1.0575	1.0403	1.0200	1.0292	1.0348
3	Deviation	0.9761	0.9970	1.0118	1.0118	0.9964	1.0001	1.0130

SECOND ITERATION

Row multipliers for inputs WO (1)

0.9500	0	0	0	0	0	0
0	1.0200	0	0	0	0	0
0	0	1.0700	0	0	0	0
0	0	0	0.9500	0	0	0
0	0	0	0	1.0200	0	0
0	0	0	0	0	1.0700	0
0	0	0	0	0	0	1.0293

Correction factors for inputs MULT

0.9781	0	0	0	0	0	0
0	0.9966	0	0	0	0	0
0	0	1.0116	0	0	0	0
0	0	0	1.0126	0	0	0
0	0	0	0	1.0126	0	0
0	0	0	0	0	1.0126	0
0	0	0	0	0	0	1.0000

Revised row multipliers for inputsWO(2) = WO * MULT

0.9292	0	0	0	0	0	0
0	1.0165	0	0	0	0	0
0	0	1.0824	0	0	0	0
0	0	0	0.9620	0	0	0
0	0	0	0	1.0329	0	0
0	0	0	0	0	1.0835	0
0	0	0	0	0	0	1.0293

Matrix T1

16.00	28.00	6.00	15.00	35.00
12.00	144.00	24.00	90.00	130.00
9.00	64.00	16.00	45.00	66.00
4.00	6.00	4.00	15.00	0.00
8.00	8.00	16.00	90.00	0.00
1.00	8.00	4.00	45.00	0.00
50.00	142.00	130.00	0.00	0.00

Input-output matrix weighted with row multipliers

14.87	26.02	5.58	13.94	32.52
12.20	146.38	24.40	91.49	132.15
9.74	69.28	17.32	48.71	71.44
3.85	5.77	3.85	14.43	0.00
8.26	8.26	16.53	92.96	0.00
1.08	8.67	4.33	48.76	0.00
51.47	146.16	133.81	0.00	0.00

Matrix T2 = WO(2) * T1

Column multipliers for acticies (sectors and final demand)

0.9500	0	0	0	0
0	1.0200	0	0	0
0	0	1.0700	0	0
0	0	0	1.0525	0
0	0	0	0	1.0164
0.95	8.16	4.28	47.36	0.00
47.50	144.84	139.10	0.00	0.00

Diagonal matrix WI

Correction factors for inputs MULT

0.9781	0	0	0	0
0	0.9966	0	0	0
0	0	1.0116	0	0
0	0	0	1.0116	0
0	0	0	0	0.9960
1.01	8.36	4.28	47.76	0.00
49.48	145.50	136.46	0.00	0.00

Matrix T1

16.00	28.00	6.00	15.00	35.00	0	0
12.00	144.00	24.00	90.00	130.00	0	0
9.00	64.00	16.00	45.00	66.00	0	0
4.00	6.00	4.00	15.00	0.00	0	0
8.00	8.00	16.00	90.00	0.00	0	0
1.00	8.00	4.00	45.00	0.00	1.0700	0
50.00	142.00	130.00	0.00	0.00	0	1.0293

Revised row multipliers for inputs WI(2) = WI * MULT

0.9292	0	0	0	0
0	1.0165	0	0	0
0	0	1.0824	0	0
0	0	0	1.0647	0
0	0	0	0	1.0123

Input-output matrix weighted with column multipliers

14.87	28.46	6.49	15.97	35.43
11.15	146.38	25.98	95.82	131.60
8.36	65.06	17.32	47.91	66.81
3.72	6.10	4.33	15.97	0.00
7.43	8.13	17.32	95.82	0.00
0.93	8.13	4.33	47.91	0.00
46.46	144.35	140.72	0.00	0.00

Matrix T3 = T1 * WI(2)

Arithmetic mean of T2 and T3

14.87	27.24	6.03	14.95	33.98
11.67	146.38	25.19	93.66	131.88
9.05	67.17	17.32	48.31	69.13
3.78	5.94	4.09	15.20	0.00
7.85	8.20	16.92	94.39	0.00
1.01	8.40	4.33	48.33	0.00
48.96	145.26	137.26	0.00	0.00

Matrix T4 = (T2 + T3)/2

Table 9: Inconsistent input-output table

	Euro	Agric 1	Indust 2	Servic 3	Consu 4	Export 5	Output 6
1	Agriculture	14.87	27.24	6.03	14.95	33.98	97.07
2	Industry	11.67	146.38	25.19	93.66	131.88	408.77
3	Services	9.05	67.17	17.32	48.31	69.13	210.97
4	Agr imported	3.78	5.94	4.09	15.20	0.00	29.01
5	Ind imported	7.85	8.20	16.92	94.39	0.00	127.36
6	Ser imported	1.01	8.40	4.33	48.33	0.00	62.07
7	Value added	46.46	144.35	140.72	0.00	0.00	331.52
8	Input	94.69	407.67	214.60	314.85	234.98	1266.79

Table 10: Input coefficients

		Agric 1	Indust 2	Servic 3	Consu 4	Export 5
1	Agriculture	0.1570	0.0668	0.0281	0.0475	0.1446
2	Industry	0.1233	0.3591	0.1174	0.2975	0.5612
3	Services	0.0956	0.1648	0.0807	0.1534	0.2942
4	Agr imported	0.0399	0.0146	0.0191	0.0483	0.0000
5	Ind imported	0.0829	0.0201	0.0789	0.2998	0.0000
6	Ser imported	0.0106	0.0206	0.0202	0.1535	0.0000
7	Value added	0.4906	0.3541	0.6557	0.0000	0.0000
8	Input	1.0000	1.0000	1.0000	1.0000	1.0000

Table 11: Leontief matrix and inverse

		Agric	Indust	Servic
		1	2	3
	Leontief matrix			
1	Agriculture	0.843	-0.067	-0.028
2	Industry	-0.123	0.641	-0.117
3	Services	-0.096	-0.165	0.919
	Inverse			
1	Agriculture	1.2131	0.1406	0.0551
2	Industry	0.2651	1.6439	0.2180
3	Services	0.1737	0.3092	1.1326

Table 12: Input-output model

		Agric	Indust	Servic	Final	Output
		1	2	3	2	3
			(I-a)-1		y	x
1	Agriculture	1.2131	0.1406	0.0551	48.93	97.54
2	Industry	0.2651	1.6439	0.2180	225.53	409.33
3	Services	0.1737	0.3092	1.1326	117.44	211.25

Table 13: Consistent input-output table

	Euro	Agric	Indust	Servic	Consu	Export	Output
		1	2	3	4	5	6
1	Agriculture	15.31	27.35	5.94	14.95	33.98	97.54
2	Industry	12.03	146.98	24.79	93.66	131.88	409.33
3	Services	9.32	67.44	17.05	48.31	69.13	211.25
4	Agr imported	3.90	5.96	4.03	15.20	0.00	29.08
5	Ind imported	8.08	8.23	16.66	94.39	0.00	127.37
6	Ser imported	1.04	8.43	4.26	48.33	0.00	62.07
7	Value added	47.86	144.93	138.52	0.00	0.00	331.31
8	Input	97.54	409.33	211.25	314.85	234.98	1267.94

Table 14: Actual versus projected growth rates of macroeconomic variables

		Value added agricul	Value added Indust	Value added servic	Con-sump-tion	Export	Total value added	Import
		1	2	3	4	5	6	7
1	Actual	0.9500	1.0200	1.0700	1.0525	1.0164	1.0293	1.0483
2	Project	0.9571	1.0207	1.0655	1.0495	1.0172	1.0289	1.0455
3	Deviation	0.9925	0.9994	1.0042	1.0029	0.9992	1.0004	1.0026

THIRD ITERATION

Iterations are continued until deviation with forecast is less than one percent.

Box 14.4 demonstrates the application of the Euro method for a numerical example.

Summary of the Euro method

Macroeconomic analysis without sectoral disaggregation in a time of structural change and innovation can be misleading. Therefore, input-output tables became an integral part of the new System of National Accounts (ESA 1995). They reflect at best the complex system of interdependent production and of value added chains of primary inputs and exchange of intermediate goods and services. Insofar, updating of input-output tables is of vital importance for applied economics.

The main advantages of the Euro update procedure are:

- robust update procedure at low costs,
- limited data requirements,
- only official sources are used for the update,
- integrated estimation of all four quadrants of the input-output table,
- no arbitrary changes of input coefficients,
- row and column totals for intermediate consumption are derived within the procedure,
- structural composition of final demand are estimated during the iteration, and
- consistency of supply and demand is provided by input-output model.

Certain disadvantages result from the simple structure of the update procedure and the underlying theory. In practice, it is a constraint that primary forecasts for output levels are normally not available. It should also be noted that the structural composition of final demand estimates in the Euro procedure is not based on econometric functions. Moreover, the impact of relative prices and other important economic variables such as innovation, technical progress, and productivity gains are not fully anticipated. In a more sophisticated econometric model, intermediate consumption would be derived in a cost minimisation approach and the structural change of final demand with econometric functions.

However, limited data requirements, low costs and the potential for a high degree of automation are the benefits of the Euro procedure. Updates for most of the Member States of the European Union have been successfully established for various years. Ex post tests for a time series of existing input-output tables indicate that a useful tool has been developed which will help to update input-output data with limited resources. The purpose of the Euro method is to fill the gap between the five-yearly harmonised input-output tables of Eurostat which are submitted by the national statistical offices on a regular basis. Another objective is to update the official input-output tables to the recent past according to the latest results of national accounts as reflected in the macroeconomic database of Eurostat. These preliminary input-output tables will help to cover the gap between the latest published input-output tables and the recent past.

Applications

chapter 15

15.1 Introduction

Input-output analysis was founded by Wassily Leontief (Leontief 1966) in the thirties of this century. He became the first Nobel Laureate and is the founding father of a new field for empirical research at the border between microeconomics and macroeconomics. He stated that "in practical terms, the economic system to which input-output analysis is applied may be as large as a nation or even the entire world economy, or as small as the economy of a metropolitan areas or even a single enterprise. In all instances the approach is essentially the same." (Leontief 1986, p. 19)

The main applications of input-output analysis have been discussed in Leontief (1984), Miller and Blair (1985), Fleissner 1993, Holub and Schnabl 1994, United Nations 1996, Kurz, Dietzenbacher and Lager 1998, and ten Raa (2006).

The structure of each sectors' production activity is represented by appropriate structural coefficients that describe in quantitative terms the relationships between the inputs it absorbs and the output it produces. The interdependence among the sectors can be described by a set of linear equations which express the balances between total input and output of each good and service produced.

The core of input-output analysis is the input-output table. It describes the flow of goods and services between all sectors of an economy over a period of time. At the same time, it provides the required information on all inputs which are used in production: intermediates, labour, capital, and land. Input-output analysis is a method of systematically quantifying the mutual interrelationships among the various sector of the economy. In so far, input-output analysis is concerned with the description and analysis of the production structure of an economy. Production processes in an economy are always interdependent. The products of one process are used in another while the product of that process may be used in many others. It is not only a system of quantifying the production of commodities by means of commodities but also a system of value added chains in interdependent markets. In a time of global markets with more competition and interdependent production, deeper division of labour and greater diversity and complexity of products, the exchange of intermediates becomes more important and, consequently, so does input-output analysis.

15.1.1 Input-output tables

The production structure of an economy is described in an input-output table. A simple example for an input-output table in currency units of an economy without foreign trade is given in Table 15.1. The table comprises four quadrants. The columns of the matrix represent the economic activities of the economy: production sectors (agriculture, industry, services) in columns 1-3 and categories of final demand (consumption, investment) in columns 4-5. The corresponding inputs of these activities are reported in the rows of the matrix: products (agriculture, industry, services) in rows 1-3 and primary inputs (wages and salaries, operating surplus) in rows 4-5.

Table 15.1: Example of an input-output table

Millions of Euro

		Agriculture	Industry	Services	Consumption	Investment	Output
		1	2	3	4	5	6
		Quadrant I			Quadrant II		
1	Agriculture	20	34	10	30	6	100
2	Industry	20	152	40	88	100	400
3	Services	10	72	20	90	8	200
		Quadrant III			Quadrant IV		
4	Wages and salaries	30	100	90	0	0	220
5	Operating surplus	20	42	40	0	0	102
6	Input	100	400	200	208	114	-

Quadrant I includes the requirements for intermediate inputs in production (intermediates). They include goods and services which are delivered and rendered by firms for other firms. In quadrant II the final use of goods and services for consumption and investment is reported (final demand). Quadrant III contains the requirements of each sector for primary inputs (labour, capital, land). In quadrant IV normally no transactions are denoted, as very few market transactions are reported in this sphere. However, in modern input-output analysis the vector of private consumption is split up into basic consumer activities (food, clothing, housing, health, transport, leisure, education, etc.) including their specific requirements for primary inputs. As the columns of an input-output table represent the cost structure of a sector and the corresponding rows the composition of its revenues, each company within a branch can identify its own position within the complex system of interdependent production including the forward and backward linkages to other industries.

The first three columns of the input-output matrix represent valuable information on the cost structure of the three sectors and their underlying production functions. They encompass all inputs in production: the uses of intermediates, of labour, of capital, and of natural resources. The relations are represented by the following production function.

(1) $x_j = f(x_{ij}, L_j, C_j, N_j)$ Production function

x_j = output of commodity j
x_{ij} = intermediate input of commodity i in sector j
L_j = Labour in sector j
C_j = Capital (machinery, buildings) in sector j
N_j = Natural resources (land, mineral resources, water, air, vegetation, animals) in sector j
F = technology and organisation (know how)

The disaggregation of branches in an input-output table helps to establish detailed information on the interdependencies in production between the various sectors of the economy. At the same time the structural composition of the final demand components (consumption, investment, exports) in terms of purchased goods and services is included in an input-output table. The residual variable ‘operating surplus’ is calculated as the difference between revenues and costs. Therefore, in input-output tables with currency units, row and column sums of the matrix match with the consequence that for each sector input equals output.

The following presentation of input-output indicators and input-output models is based on an empirical example. In Table 15.3 we have chosen the Input-Output Table 1995 for Germany to be the reference case as this country is fairly advanced in developing satellite systems extending the traditional set of input-output tables. The input-output tables of Germany include 59 branches according to the P60 classification of the Classification of Products by Activity (CPA). We have aggregated this table to 6 branches (P6) for the presentation in this manual. The six branches are defined in Table 15.2.

Table 15.2: Definition of the aggregate branches

No.	Name	Description	CPA
1	Agriculture	Products of agriculture, forestry, fisheries and aquaculture	A + B
2	Manufacturing	Products of mining and quarrying, manufactured products and energy products	C + D + E
3	Construction	Construction work	F
4	Trade	Wholesale and retail trade, repair services, hotel and restaurant services, transport and communication services	G + H + I
5	Business services	Financial intermediation services, real estate, renting and business services	I + K
6	Other services	Other services	L to P

The first part of the extended input-output table comprises the traditional part. It includes:

- Rows 1 - 6: Domestic production of goods and services
- Rows 8 - 13: Imports of goods and services
- Rows 17 - 20: Components of value added (compensation of employees, other net taxes on production, consumption of fixed capital, operating surplus).

Table 15.3: Extended input-output table at basic prices with satellite systems

INPUT-OUTPUT TABLE (Millions of Euro)

No.		INPUT OF PRODUCTION ACTIVITIES						FINAL USES					Output at basic prices
		Agri-culture	Manufac-turing	Con-struc-tion	Trade	Business services	Other services	Private con-sump-tion	Govern-ment con-sump-tion	Gross fixed capital forma-tion	Changes in inven-tories	Exports	
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11	12
1	Agriculture	1 131	25 480	1	607	710	762	8 500	16	2 975	- 6	3 734	43 910
2	Manufacturing	7 930	304 584	64 167	41 082	11 981	30 360	197 792	8 588	91 692	7 559	313 711	1 079 446
3	Construction	426	7 334	3 875	5 296	23 457	9 155	3 457	742	191 715		149	245 606
4	Trade	3 559	72 717	14 190	74 399	10 835	21 008	269 663	13 492	14 155		46 045	540 063
5	Business services	3 637	96 115	31 027	65 755	193 176	34 223	214 757	10 061	30 124		13 612	692 487
6	Other services	1 552	14 986	1 747	11 225	15 058	22 070	119 504	317 251	3 483		2 042	508 918
7	Domestic products	18 235	521 216	115 007	198 364	255 217	117 578	813 673	350 150	334 144	7 553	379 293	3 110 430
8	Agriculture	202	8 884		375	1	344	5 467			31	705	16 009
9	Manufacturing	2 601	141 222	11 379	9 907	2 519	7 019	69 918	2 816	39 778	- 4 264	41 853	324 748
10	Construction	2	562	1 039	29	137	38			1 069			2 876
11	Trade	119	3 335	445	9 956	621	817	4 483	21	263		9	20 069
12	Business services	3	2 225	564	1 523	9 785	1 525	155		326		4	16 110
13	Other services		475		153	308	4 029	164	133			26	5 288
14	Imported products	2 927	156 703	13 427	21 943	13 371	13 772	80 187	2 970	41 436	- 4 233	42 597	385 100
15	Taxes less subsidies on products	1 084	6 505	1 548	8 349	8 473	12 551	107 200	3 670	28 660	260	- 1 160	177 140
16	Intermediate consumption/ Final use at purchasers' prices	22 246	684 424	129 982	228 656	277 061	143 901	1 001 060	356 790	404 240	3 580	420 730	3 672 670
17	Compensation of employees	9 382	296 464	78 819	214 450	124 810	272 975						996 900
18	Other net taxes on production	- 2 012	1 457	963	2 748	5 946	- 8 602						500
19	Consumption of fixed capital	7 871	63 769	5 860	41 100	98 610	49 260						266 470
20	Net operating surplus	6 423	33 332	29 982	53 109	186 060	51 384						360 290
21	Value added at basic prices	21 664	395 022	115 624	311 407	415 426	365 017						1 624 160
22	Output at basic prices	43 910	1 079 446	245 606	540 063	692 487	508 918						
GROSS FIXED CAPITAL FORMATION (Millions of Euro)													
23	Machinery	4 468	54 716	6 634	32 023	41 205	21 526						160 571
24	Buildings	2 032	18 726	2 346	22 281	169 787	54 885						270 057
25	Total	6 500	73 441	8 980	54 303	210 992	76 411						430 628
CAPITAL STOCK (Millions of Euro)													
26	Machinery	86 347	726 829	58 209	342 406	312 814	187 269						1 713 873
27	Buildings	162 751	564 431	49 653	551 907	4 530 390	1 683 774						7 542 906
28	Total	249 098	1 291 259	107 862	894 313	4 843 203	1 871 044						9 256 779
EMPLOYMENT (1.000 persons)													
29	Wage and salary earners	483	8 032	2 896	7 977	3 653	9 555						32 596
30	Self-employed	613	349	340	1 274	605	651						3 832
31	Total	1 096	8 381	3 236	9 251	4 258	10 206						36 428

ENERGY (Terajoule)

32	Coal	1 416	2 030 427	1 719	1 864	103	2 973	13 892			- 114 227	54 220	1 992 387
33	Lignite		1 809 327		53	145	2 759	28			4 358	9 125	1 825 796
34	Crude oil		4 399 992								- 9 518	17 412	4 407 886
35	Natural gas	8 918	1 765 883	6 252	104 071	44 906	134 656	796 510			5 828	76 732	2 943 757
36	Nuclear fuels		1 681 890										1 681 890
37	Water power		174 842	10	1 504	614	1 593	96 148					274 711
38	Briquettes	6 929	16 184	8 089	233	137	7 485	74 813			- 4 112	10 662	120 421
39	Coke	991	446 171	867	1 242	74	344	14 898			- 38 908	23 431	449 111
40	Petroleum products	129 239	2 115 018	263 929	1 268 108	85 390	257 518	2 181 013			- 58 604	648 299	6 889 908
41	Electricity	19 505	1 047 181	3 050	172 713	43 112	116 427	469 415			82 426	125 680	2 079 509
42	Produced gas	557	567 955	796	1 703	438	2 727	45 188			20 278	29 894	669 537
43	Steam, hot water	1 219	81 419	2 044	30 372	13 259	66 399	166 687			36 100		397 500
44	Total	168 775	16 136 288	286 757	1 581 864	188 179	592 882	3 858 593			- 76 379	995 454	23 732 412

EMISSIONS (1.000 tons)

45	Carbon dioxide (CO_2)	10 448	558 327	11 194	71 269	8 792	26 990	217 137					904 158
46	Methane (CH_4)	1 534	1 160	1	4	1	1 058	136					3 894
47	Nitrous oxide (N_2O)	77	100		3		11	17					209
48	Sulfur dioxide (SO_2)	12	1 705	18	50	4	24	180					1 994
49	Nitrogen oxides (NOx)	62	722	64	452	23	58	585					1 967
50	Carbon monoxide (CO)	43	1 616	86	434	103	188	4 198					6 667
51	Organic compounds (NMVOC)	20	1 209	17	101	15	143	520					2 024
52	Dust particles	57	165	7	34	1	7	58					329
53	Total	12 252	565 005	11 388	72 347	8 939	28 479	222 831					921 241

GLOBAL WARMING AND ACID DEPOSITION (1.000 tons)

54	Greenhouse gases 2)	66 423	613 832	11 350	72 327	8 944	52 740	224 185					1 049 801
55	Acid deposition 3)	55	2 211	63	366	20	64	584					3 365

SOLID WASTES (1.000 tons)

56	Waste	77	152 205	153 932	8 850	11 360	10 883	28 873					366 180
57	Sewage	33	39 898	36	171	220	204	3 409					43 971

1) Including consumption of fixed capital
2) Carbon dioxide (CO_2 = 1), methane (CH_4 = 21) and nitrous oxide (N_2O x 310) were transformed with the documented factors to greenhouse gases in CO_2 equivalents.
3) Sulfur dioxide (SO_2 = 1) and nitrogen oxides (NO_x = 0.7) were transformed with the documented factors to acid depositions in SO_2 equivalents.

Germany 1995

The matrices below the input-output table are satellite systems which are integrated into the input-output framework. They provide useful information on investment (machinery, buildings), capital (machinery, buildings), and employment (wage and salary earners, self-employed) of the various industries.

The next matrices of the satellite system contain information on primary energy (coal, lignite, crude oil, natural gas, nuclear fuels, water power), secondary energy (briquettes, coke, petroleum products, electricity, produced gas, steam and hot water) and the corresponding emissions (carbon dioxide CO_2, methane CH_4, nitrous oxide N_2O, sulphur dioxide SO_2, Nitrogen oxides NO_x, Carbon monoxide CO, non-methane volatile organic compounds NMVOC, black smoke) and other residuals (waste, sewage) of the various production and consumption activities. It should be noted that the first three matrices are given in values (input-output table, investment, capital), while the following matrices reflect quantities (labour, energy, emissions, waste).

In input-output analysis, two types of input-output tables are distinguished as demonstrated by Version A and Version B.

Table 15.4: Input-output table of domestic output at basic prices (Version A)

Millions of Euro

No.		INPUT OF PRODUCTION ACTIVITIES						FINAL USES					
		Agri-cul-ture	Manufac-turing	Con-struc-tion	Trade	Busi-ness services	Other services	Private con-sumption	Govern-ment con-sump-tion	Gross fixed capital forma-tion	Chang-es in inven-tories	Exports	Output at basic prices
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11	12
1	Agriculture	1 131	25 480	1	607	710	762	8 500	16	2 975	- 6	3 734	43 910
2	Manufacturing	7 930	304 584	64 167	41 082	11 981	30 360	197 792	8 588	91 692	7 559	313 711	1 079 446
3	Construction	426	7 334	3 875	5 296	23 457	9 155	3 457	742	191 715		149	245 606
4	Trade	3 559	72 717	14 190	74 399	10 835	21 008	269 663	13 492	14 155		46 045	540 063
5	Business services	3 637	96 115	31 027	65 755	193 176	34 223	214 757	10 061	30 124		13 612	692 487
6	Other services	1 552	14 986	1 747	11 225	15 058	22 070	119 504	317 251	3 483		2 042	508 918
7	Domestic products	18 235	521 216	115 007	198 364	255 217	117 578	813 673	350 150	334 144	7 553	379 293	3 110 430
8	Imported products	2 927	156 703	13 427	21 943	13 371	13 772	80 187	2 970	41 436	- 4 233	42 597	385 100
9	Taxes less subsidies on products	1 084	6 505	1 548	8 349	8 473	12 551	107 200	3 670	28 660	260	- 1 160	177 140
10	Intermediate consumption/Final use at purchasers' prices	22 246	684 424	129 982	228 656	277 061	143 901	1 001 060	356 790	404 240	3 580	420 730	3 672 670
11	Compensation of employees	9 382	296 464	78 819	214 450	124 810	272 975						996 900
12	Other net taxes on production	- 2 012	1 457	963	2 748	5 946	- 8 602						500
13	Consumption of fixed capital	7 871	63 769	5 860	41 100	98 610	49 260						266 470
14	Net operating surplus	6 423	33 332	29 982	53 109	186 060	51 384						360 290
15	Value added at basic prices	21 664	395 022	115 624	311 407	415 426	365 017						1 624 160
16	Output at basic prices	43 910	1 079 446	245 606	540 063	692 487	508 918	1 001 060	356 790	404 240	3 580	420 730	-

Germany 1995

Table 15.5: Input-output table of domestic output at basic prices (Version B)

Millions of Euro

No.		INPUT OF PRODUCTION ACTIVITIES						FINAL USES					
		Agri-cul-ture	Manufac-turing	Con-struc-tion	Trade	Busi-ness services	Other services	Private con-sumption	Govern-ment con-sump-tion	Gross fixed capital forma-tion	Chang-es in inven-tories	Net exports	Output at basic prices
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11	12
1	Agriculture	1 333	34 364	1	982	711	1 106	13 967	16	2 975	25	- 11 570	43 910
2	Manufacturing	10 531	445 806	75 546	50 989	14 500	37 379	267 710	11 404	131 470	3 295	30 816	1 079 446
3	Construction	428	7 896	4 914	5 325	23 594	9 193	3 457	742	192 784		- 2 727	245 606
4	Trade	3 678	76 052	14 635	84 355	11 456	21 825	274 146	13 513	14 418		25 985	540 063
5	Business services	3 640	98 340	31 591	67 278	202 961	35 748	214 912	10 061	30 450		- 2 494	692 487
6	Other services	1 552	15 461	1 747	11 378	15 366	26 099	119 668	317 384	3 483		- 3 220	508 918
7	Total products	21 162	677 919	128 434	220 307	268 588	131 350	893 860	353 120	375 580	3 320	36 790	3 110 430
8	Taxes less subsidies on products	1 084	6 505	1 548	8 349	8 473	12 551	107 200	3 670	28 660	260	- 1 160	177 140
9	Intermediate consumption/ Final use at purchasers' prices	22 246	684 424	129 982	228 656	277 061	143 901	1 001 060	356 790	404 240	3 580	35 630	3 287 570
10	Compensation of employees	9 382	296 464	78 819	214 450	124 810	272 975						996 900
11	Other net taxes on production	- 2 012	1 457	963	2 748	5 946	- 8 602						500
12	Consumption of fixed capital	7 871	63 769	5 860	41 100	98 610	49 260						266 470
13	Net operating surplus	6 423	33 332	29 982	53 109	186 060	51 384						360 290
14	Value added at basic prices	21 664	395 022	115 624	311 407	415 426	365 017						1 624 160
15	Output at basic prices	43 910	1 079 446	245 606	540 063	692 487	508 918	1 001 060	356 790	404 240	3 580	35 630	-

Germany 1995

The only difference between the core of the previous table and the extended input-output table for domestic output in Table 15.4 is that the imported products were aggregated to one row vector of imports. It is typical for an input-output table of type Version A that the use of domestic products is shown in rows 1-6. The use of aggregate imports is shown in row 8. The inputs comprise domestic products (row 1-6), imported products (row 8), net taxes on products (row 9) and the components of value added (row 11-14).

For analytical purposes the input-output table of Table 15.3 has been transformed into a different form of aggregation. In a first step, the matrices for domestic production (rows 1-6) and imports (rows 8-13) are aggregated to total supply of goods and services. The results of this aggregation are presented in Table 15.4 as Version B of the input-output table for domestic output. As domestic output is the difference of total supply less imports, the export vector (column 11) is reduced in the second step by the vector for total imports (column 12, rows 8 – 14) in Table 15.3. The result of this calculation is the net export vector (column 11) in Table 15.4.

Domestic intermediates and final demand commodities may be substituted by foreign goods and services if relative prices and exchange rates change in an unfavourable way for the domestic economy. It can be assumed that the input-output table in Table 15.5 is a more appropriate form to identify stable cost components and technical input relations while the input-output table in Table 15.4 is the better option to study the impact on the domestic economy and import substitution. Therefore the derived input coefficients of Table 15.5 are sometimes called 'technical' coefficients.

15.1.2 Input-Output coefficients

Input-output analysis starts with the calculation of input-output coefficients. In Table 15.6 we have established the input coefficients for the Input-Output table of Germany 1990 (Table 15.2). They are calculated by dividing each entry of the input-output table by the corresponding column total. The input coefficients can be interpreted as the corresponding shares of costs for goods, services and primary inputs in total output. As the input coefficients cover all inputs including the residual variable 'operating surplus' they add up to unity.

For quadrant I (domestic intermediates) the input coefficients of a sector are defined as:

(2) $a_{ij} = x_{ij}/x_j$ Input coefficients for domestic intermediates

a_{ij} = input coefficient for domestic goods and services (i = 1, ..., 6; j = 1, ..., 6)
x_{ij} = flow of domestic commodity i to sector j
x_j = output of sector j

For section III (imported intermediates) the input coefficients of a sector are defined as:

(3) $b_{ij} = m_{ij}/x_j$ Input coefficients for imported intermediates

b_{ij} = input coefficient for imported goods and services (i = 7, ..., 12; j = 1, ..., 6)
m_{ij} = flow of imported commodity i to sector j
x_j = output of sector j

For section V (value added) the input coefficients of a sector are defined as:

(4) $w_{ij} = z_{ij}/x_j$ Input coefficients for other primary inputs

w_{ij} = input coefficient (i = 13, ..., 17; j = 1, ..., 6)
z_{ij} = flow of primary input i to sector j
x_j = output of sector j

In Table 15.7 we have calculated the corresponding output coefficients. They can be interpreted as the shares in total output (revenue) or market shares for commodities and primary inputs. For value added they reflect the distribution of primary inputs. The output coefficients are calculated by dividing each entry of the input-output table by the corresponding row total.

Table 15.6: Input coefficients

No.		INPUT OF PRODUCTION ACTIVITIES						FINAL USES				
		Agriculture	Manufacturing	Construction	Trade	Business services	Other services	Private consumption	Government consumption	Gross fixed capital formation	Changes in inventories	Exports
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11
1	Agriculture	0.0258	0.0236	0.0000	0.0011	0.0010	0.0015	0.0085	0.0000	0.0074	-0.0017	0.0089
2	Manufacturing	0.1806	0.2822	0.2613	0.0761	0.0173	0.0597	0.1976	0.0241	0.2268	2.1115	0.7456
3	Construction	0.0097	0.0068	0.0158	0.0098	0.0339	0.0180	0.0035	0.0021	0.4743	0.0000	0.0004
4	Trade	0.0811	0.0674	0.0578	0.1378	0.0156	0.0413	0.2694	0.0378	0.0350	0.0000	0.1094
5	Business services	0.0828	0.0890	0.1263	0.1218	0.2790	0.0672	0.2145	0.0282	0.0745	0.0000	0.0324
6	Other services	0.0353	0.0139	0.0071	0.0208	0.0217	0.0434	0.1194	0.8892	0.0086	0.0000	0.0049
7	Agriculture imported	0.0046	0.0082	0.0000	0.0007	0.0000	0.0007	0.0055	0.0000	0.0000	0.0087	0.0017
8	Manufacturing imported	0.0592	0.1308	0.0463	0.0183	0.0036	0.0138	0.0698	0.0079	0.0984	-1.1911	0.0995
9	Construction imported	0.0000	0.0005	0.0042	0.0001	0.0002	0.0001	0.0000	0.0000	0.0026	0.0000	0.0000
10	Trade imported	0.0027	0.0031	0.0018	0.0184	0.0009	0.0016	0.0045	0.0001	0.0007	0.0000	0.0000
11	Business services imported	0.0001	0.0021	0.0023	0.0028	0.0141	0.0030	0.0002	0.0000	0.0008	0.0000	0.0000
12	Other services imported	0.0000	0.0004	0.0000	0.0003	0.0004	0.0079	0.0002	0.0004	0.0000	0.0000	0.0001
13	Taxes less subsidies on products	0.0247	0.0060	0.0063	0.0155	0.0122	0.0247	0.1071	0.0103	0.0709	0.0726	-0.0028
14	Compensation of employees	0.2137	0.2746	0.3209	0.3971	0.1802	0.5364	0.0000	0.0000	0.0000	0.0000	0.0000
15	Other net taxes on production	-0.0458	0.0013	0.0039	0.0051	0.0086	-0.0169	0.0000	0.0000	0.0000	0.0000	0.0000
16	Consumption of fixed capital	0.1793	0.0591	0.0239	0.0761	0.1424	0.0968	0.0000	0.0000	0.0000	0.0000	0.0000
17	Net operating surplus	0.1463	0.0309	0.1221	0.0983	0.2687	0.1010	0.0000	0.0000	0.0000	0.0000	0.0000
18	Output at basic prices	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 15.7: Output coefficients

No.		PRODUCTION ACTIVITIES						FINAL USES					
		Agriculture	Manufacturing	Construction	Trade	Business services	Other services	Private consumption	Government consumption	Gross fixed capital formation	Changes in inventories	Exports	Output at basic prices
	PRODUCTS (CPA)	1	2	3	4	5	6	7	8	9	10	11	12
1	Agriculture	0.0258	0.5803	0.0000	0.0138	0.0162	0.0174	0.1936	0.0004	0.0678	-0.0001	0.0850	1.0000
2	Manufacturing	0.0073	0.2822	0.0594	0.0381	0.0111	0.0281	0.1832	0.0080	0.0849	0.0070	0.2906	1.0000
3	Construction	0.0017	0.0299	0.0158	0.0216	0.0955	0.0373	0.0141	0.0030	0.7806	0.0000	0.0006	1.0000
4	Trade	0.0066	0.1346	0.0263	0.1378	0.0201	0.0389	0.4993	0.0250	0.0262	0.0000	0.0853	1.0000
5	Business services	0.0053	0.1388	0.0448	0.0950	0.2790	0.0494	0.3101	0.0145	0.0435	0.0000	0.0197	1.0000
6	Other services	0.0030	0.0294	0.0034	0.0221	0.0296	0.0434	0.2348	0.6234	0.0068	0.0000	0.0040	1.0000
7	Agriculture	0.0059	0.1676	0.0370	0.0638	0.0821	0.0378	0.2616	0.1126	0.1074	0.0024	0.1219	1.0000
8	Manufacturing	0.0126	0.5549	0.0000	0.0234	0.0001	0.0215	0.3415	0.0000	0.0000	0.0019	0.0440	1.0000
9	Construction	0.0080	0.4349	0.0350	0.0305	0.0078	0.0216	0.2153	0.0087	0.1225	-0.0131	0.1289	1.0000
10	Trade	0.0007	0.1954	0.3613	0.0101	0.0476	0.0132	0.0000	0.0000	0.3717	0.0000	0.0000	1.0000
11	Business services	0.0059	0.1662	0.0222	0.4961	0.0309	0.0407	0.2234	0.0010	0.0131	0.0000	0.0004	1.0000
12	Other services	0.0002	0.1381	0.0350	0.0945	0.6074	0.0947	0.0096	0.0000	0.0202	0.0000	0.0002	1.0000
13	Taxes less subsidies on products	0.0000	0.0898	0.0000	0.0289	0.0582	0.7619	0.0310	0.0252	0.0000	0.0000	0.0049	1.0000
14	Compensation of employees	0.0076	0.4069	0.0349	0.0570	0.0347	0.0358	0.2082	0.0077	0.1076	-0.0110	0.1106	1.0000
15	Other net taxes on production	0.0061	0.0367	0.0087	0.0471	0.0478	0.0709	0.6052	0.0207	0.1618	0.0015	-0.0065	1.0000
16	Consumption of fixed capital	0.0061	0.1864	0.0354	0.0623	0.0754	0.0392	0.2726	0.0971	0.1101	0.0010	0.1146	1.0000
17	Net operating surplus	0.0094	0.2974	0.0791	0.2151	0.1252	0.2738	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000

For quadrant I (intermediates) and quadrant II (final demand) the output coefficients of a sector are:

(5) $o_{ij} = x_{ij}/x_i$ Output coefficients

o_{ij} = output coefficient for domestic goods and services (i = 1, ..., 6; j = 1, ..., 6)
x_{ij} = flow of commodity i to sector j
x_i = output of sector i

15.1.3 Static input-output model

A well known input-output model is the static input-output system of Wassily Leontief. It is a linear model which is based on Leontief production functions and a given vector of final demand. The objective is to calculate the unknown activity (output) levels for the individual sectors (endogenous variables) for the given final demand (exogenous variables). In the following example, we are presenting this basic model for an economy with 3 sectors.

The balance between total input and outputs can be described by the following set of equations:

(6) $x_{11} + x_{12} + x_{13} + x_{1d} = x_1$ Definition equations
(7) $x_{21} + x_{22} + x_{23} + x_{2d} = x_{2*}$
(8) $x_{31} + x_{32} + x_{33} + x_{3d} = x_3$

x_{ij} = intermediates from sector i to sector j
x_{id} = final demand for commodity i
x_j = output of sectors j

We assume that all sectors produce with linear Leontief production functions. All inputs (intermediates, capital, labour, land) are used in fixed proportions in relation to output. It is assumed that a substitution of inputs is impossible. Therefore, changing factor prices have no influence on the technical input coefficients.

(9) $a_{ij} = x_{ij}/x_j$ Input coefficients for domestic intermediates

The requirements for intermediates can be defined as the set of input coefficients weighted with the corresponding output level.

(10) $x_{ij}=a_{ij}\,x_j$ Requirements for intermediates

If we accept the assumption that the sectors produce with fixed technical input coefficients, the equation system (6)-(8) can be rewritten by replacing x_{ij} by $a_{ij}\,x_j$. These equations serve to make explicit the dependence of interindustry flows on the total output of each sector.

(11) $a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + x_{1d} = x_1$ Input-Output System
(12) $a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + x_{2d} = x_2$
(13) $a_{31}x_1 + a_{32}x_2 + a_{33}x_3 + x_{3d} = x_3$

Table 15.8: Input coefficients for domestic intermediates

		Agriculture	Manufacturing	Construction	Trade	Business services	Other services
		1	2	3	4	5	6
1	Agriculture	0.0258	0.0236	0.0000	0.0011	0.0010	0.0015
2	Manufacturing	0.1806	0.2822	0.2613	0.0761	0.0173	0.0597
3	Construction	0.0097	0.0068	0.0158	0.0098	0.0339	0.0180
4	Trade	0.0811	0.0674	0.0578	0.1378	0.0156	0.0413
5	Business services	0.0828	0.0890	0.1263	0.1218	0.2790	0.0672
6	Other services	0.0353	0.0139	0.0071	0.0208	0.0217	0.0434

This set of equations is transformed into the following Leontief equation system. The equation system has the following features:

- final demand (exogenous variable) is isolated on the right side of the equation,
- net output (output less intrasectoral consumption) is identified on the diagonal of the matrix,
- inputs have a negative sign, output have a positive sign.

If the vector of final demand and the technical coefficients are known, the Leontief equation system is simply a set of linear equations with unknown output levels. The objective is to derive the activity levels of industries for the given level of demand.

$$\begin{array}{llllll} (14) & (1-a_{11})x_1 & -a_{12}x_2 & -a_{13}x_3 & = x_{1d} & \text{Leontief matrix} \\ (15) & -a_{21}x_1 & +(1-a_{22})x_2 & -a_{23}x_3 & = x_{2d} & \\ (16) & -a_{31}x_1 & -a_{32}x_2 & +(1-a_{33})x_3 & = x_{3d} & \end{array}$$

Table 15.9: Leontief matrix

		Agriculture	Manufacturing	Construction	Trade	Business services	Other services
		1	2	3	4	5	6
1	Agriculture	0.9742	-0.0236	0.0000	-0.0011	-0.0010	-0.0015
2	Manufacturing	-0.1806	0.7178	-0.2613	-0.0761	-0.0173	-0.0597
3	Construction	-0.0097	-0.0068	0.9842	-0.0098	-0.0339	-0.0180
4	Trade	-0.0811	-0.0674	-0.0578	0.8622	-0.0156	-0.0413
5	Business services	-0.0828	-0.0890	-0.1263	-0.1218	0.7210	-0.0672
6	Other services	-0.0353	-0.0139	-0.0071	-0.0208	-0.0217	0.9566

In matrix terms, we define:

(17) $Ax + y = x$
(18) $x - Ax = y$
(19) $(I - A)x = y$

The solution of this linear equation system is:

(20) $x = (I - A)^{-1} y$

A = matrix of input coefficients for intermediates (technology matrix)
I = unit matrix
$(I - A)$ = Leontief matrix
$(I - A)^{-1}$ = Leontief inverse
y = vector of final demand
x = vector of output

In the matrix algebra we denote vectors in small letters and matrices in capital letters. Vector Ax reflects the requirements for intermediates, while vector y represents the exogenous aggregate final demand. The matrix (I-A) is called Leontief matrix. On the diagonal of this matrix the net output is given for each sector with positive coefficients (revenues) while the rest of the matrix covers the input requirements with negative coefficients (costs). The Leontief inverse $(I-A)^{-1}$ reflects the direct and indirect requirements for intermediates.

On the diagonal of the Leontief matrix in Table 15.9, the net-output (positive sign) of each sector is reported. The other coefficients in the matrix represent input requirements (negative sign). For the sector 'Agriculture' for example, intrasectoral input requirements of 0.0258 product units of its own kind are reported. The internal input requirements for agricultural goods are approximately 2.6 percent of output. Therefore, the net-output of this sector is below unity (0.9742).

The cumulative input coefficients in Table 15.8 reflect the direct and indirect requirements for domestic intermediates for one unit of final demand. For 'Agriculture' an output multiplier of 1.7048 is reported. The difference between Table 15.10 and Table 15.8 corresponds to the indirect input requirements of the economy.

The inverse can be approximated by the power series of A matrices:

(21) $(I - A)^{-1} = I + A + A^2 + A^3 + ... + A^n$ Power series approximation of the inverse

Table 15.10: Inverse

		Agriculture	Manufacturing	Construction	Trade	Business services	Other services
		1	2	3	4	5	6
1	Agriculture	1.0339	0.0350	0.0100	0.0051	0.0030	0.0044
2	Manufacturing	0.2896	1.4292	0.3961	0.1420	0.0596	0.1073
3	Construction	0.0207	0.0191	1.0289	0.0211	0.0500	0.0250
4	Trade	0.1269	0.1214	0.1064	1.1784	0.0356	0.0631
5	Business services	0.1842	0.2071	0.2503	0.2239	1.4126	0.1269
6	Other services	0.0495	0.0295	0.0218	0.0331	0.0342	1.0515
8	Total	1.7048	1.8413	1.8136	1.6035	1.5951	1.3782

In this notation of the inverse, the unit matrix I denotes, on the diagonal, one unit of the commodity for final demand. Matrix A represents the direct input requirements of the producer for intermediates and matrices A^2 until A^n the indirect requirements for intermediates at the previous stages of production. The column sum of the inverse can be interpreted as output multiplier which reflects the cumulative revenues of the economy which are induced by one additional unit of final demand of a certain commodity. In our case 'Manufacturing' (1.8413) has the highest output multiplier. If final demand for industrial products increased by 1.0 m EUR, cumulative revenues of 1.841 m EUR would be induced in the economy.

Box 15.1: Static input-output model

APPROACH A

Only quantities are known.

Table 1: Input-output table (quantities)

	A	B	C	Final demand	Output
A	4.0	6.8	2.0	7.2	20.0
B	10.0	76.0	20.0	94.0	200.0
C	2.5	18.0	5.0	24.5	50.0
Value added	5.0	14.2	13.0	0.0	32.2

Table 2: Prices

	A	B	C	Final demand	Output
A	Information not available				
B					
C					
Value added					

APPROACH B

Quantities, prices and values are known.

Table 1: Input-output table (quantities)

	A	B	C	Final demand	Output
A	4.0	6.8	2.0	7.2	20.0
B	10.0	76.0	20.0	94.0	200.0
C	2.5	18.0	5.0	24.5	50.0
Value added	5.0	14.2	13.0	0.0	32.2

Table 2: Prices

	A	B	C	Final demand	
A	5.00	5.00	5.00	5.00	
B	2.00	2.00	2.00	2.00	
C	4.00	4.00	4.00	4.00	
Value added	10.00	10.00	10.00	10.00	

Table 3: Input-output table (values)

	A	B	C	Final demand	Output
A	Information not available				
B					
C					
Value added					
Input					

Table 4: Input coefficients (quantities/quantities)

	A	B	C	Final demand	
A	0.2000	0.0340	0.0400	0.2236	
B	0.5000	0.3800	0.4000	2.9193	
C	0.1250	0.0900	0.1000	0.7609	
Value added	0.2500	0.0710	0.2600	0.0000	

Table 5: Input coefficients intermediates

	A	B	C		
A	0.2000	0.0340	0.0400		
B	0.5000	0.3800	0.4000		
C	0.1250	0.0900	0.1000		

Table 6: Leontief matrix

	A	B	C		
A	0.8000	-0.0340	-0.0400		
B	-0.5000	0.6200	-0.4000		
C	-0.1250	-0.0900	0.9000		

Table 7: Inverse and input-output model (quantities)

	A	B	C	Final demand	Output
A	1.3192	0.0864	0.0970	7.2	20.0
B	1.2636	1.8069	0.8592	94.0	200.0
C	0.3096	0.1927	1.2105	24.5	50.0

Table 3: Input-output table (values)

	A	B	C	Final demand	Output
A	20.00	34.00	10.00	36.00	100.00
B	20.00	152.00	40.00	188.00	400.00
C	10.00	72.00	20.00	98.00	200.00
Value added	50.00	142.00	130.00	0.00	322.00
Input	100.00	400.00	200.00	322.00	0.00

Table 4: Input coefficients (values/values)

	A	B	C	Final demand	
A	0.2000	0.0850	0.0500	0.1118	
B	0.2000	0.3800	0.2000	0.5839	
C	0.1000	0.1800	0.1000	0.3043	
Value added	0.5000	0.3550	0.6500	0.0000	

Table 5: Input coefficients intermediates

	A	B	C		
A	0.2000	0.0850	0.0500		
B	0.2000	0.3800	0.2000		
C	0.1000	0.1800	0.1000		

Table 6: Leontief matrix

	A	B	C		
A	0.8000	-0.0850	-0.0500		
B	-0.2000	0.6200	-0.2000		
C	-0.1000	-0.1800	0.9000		

Table 7: Inverse and input-output model (values)

	A	B	C	Final demand	Output
A	1.3192	0.2161	0.1213	36.00	100.00
B	0.5054	1.8069	0.4296	188.00	400.00
C	0.2477	0.3854	1.2105	98.00	200.00

The solution of the static input-output system $(I-A)^{-1}y = x$ in equation (20) is included in Table 15.11. The objective of this calculation is to restore the input-output table of Table 15.3 with the static input-output model. The inverse is multiplied with the vector of final demand to estimate the output levels. This model is often used to study the impact of exogenous changes of final demand on the economy. The best known application of the static input-output model is the evaluation of a Keynesian public expenditure program to fight a recession or unemployment.

Table 15.11: Static input-output model

		Agriculture	Manufacturing	Construction	Trade	Business services	Other services	Final demand	Output
		1	2	3	4	5	6	7	8
		Leontief inverse (I-A)-1						y	x
1	Agriculture	1.0339	0.0350	0.0100	0.0051	0.0030	0.0044	15 219	43 910
2	Manufacturing	0.2896	1.4292	0.3961	0.1420	0.0596	0.1073	619 342	1 079 446
3	Construction	0.0207	0.0191	1.0289	0.0211	0.0500	0.0250	196 063	245 606
4	Trade	0.1269	0.1214	0.1064	1.1784	0.0356	0.0631	343 355	540 063
5	Business services	0.1842	0.2071	0.2503	0.2239	1.4126	0.1269	268 554	692 487
6	Other services	0.0495	0.0295	0.0218	0.0331	0.0342	1.0515	442 280	508 918

15.1.4 Price model

Prices are determined in an input-output system from a set of equations which states that the price which each sector of the economy receives per unit of output must equal the total outlays incurred in the course of its production. The outlays comprise not only payments for inputs purchased from the same and from other industries but also the value added, which essentially represents payments made to the exogenous factors, e.g. capital, labour, and land.

In the input-output table the costs of production are reported for each sector in the corresponding column of the matrix. The transposed columns are reported in the following system.

(22) $x_{11}p_1 + x_{21}p_2 + x_{31}p_3 + z_1q = x_1p_1$ Price model
(23) $x_{12}p_1 + x_{22}p_2 + x_{32}p_3 + z_2q = x_2p_2$
(24) $x_{13}p_1 + x_{23}p_2 + x_{33}p_3 + z_3q = x_3p_3$

x_{ij} = intermediates from sector i to sector j (quantity)
x_j = output of sector j (quantity)
p_i = price of commodity i
z_j = primary input to sector j (quantity)
q = factor price for primary input (e.g. wage rate)

Again, we assume that all three sectors are producing with Leontief production functions. Moreover, by calculating implicit prices we assume that the conditions for full competition (many suppliers, many purchasers, free access to markets, full information) are valid.

(25) $a_{ij} = x_{ij}/x_j$ Input coefficients for domestic intermediates
(26) $v_j = z_j/x_j$ Input coefficient for primary input (value added)

The requirements for intermediates can be defined as the input coefficient weighted with the corresponding output level.

(27) $x_{ij} = a_{ij}\,x_j$ Requirements for intermediates(goods and services)
(28) $z_j = v_jx_j$ Requirements for primary inputs (capital, labour)

a_{ij} = input coefficient for commodities
z_j = requirements for primary input (quantity)
v_j = input coefficient for primary input

In the next step we introduce the input coefficients for intermediates and primary input into the equation system.

(29) $a_{11}x_1p_1 + a_{21}x_1p_2 + a_{31}x_1p_3 + v_1x_1q = x_1p_1$ Price model
(30) $a_{12}x_2p_1 + a_{22}x_2p_2 + a_{32}x_2p_3 + v_2x_2q = x_2p_2$
(31) $a_{13}x_3p_1 + a_{23}x_3p_2 + a_{33}x_3p_3 + v_3x_3q = x_3p_3$

Box 15.2: Price model

APPROACH A

Only quantities and wage rate are known.

Table 1: Input-output table (quantities)

	A	B	C	Final demand	Output
A	4.0	6.8	2.0	7.2	20.0
B	10.0	76.0	20.0	94.0	200.0
C	2.5	18.0	5.0	24.5	50.0
Value added	5.0	14.2	13.0	0.0	32.2

Table 2: Prices

A	Information on product prices not available				
B					
C					
Value added	10.00	10.00	10.00	10.00	

Table 3: Input-output table (values)

	A	B	C	Final demand	Output
A	Information on values of products not available				
B					
C					
Value added					
Input	50.0	142.0	130.0	0.0	322.0

Table 4: Input coefficients (quantities/quantities)

	A	B	C	Final demand	
A	0.2000	0.0340	0.0400	0.2236	
B	0.5000	0.3800	0.4000	2.9193	
C	0.1250	0.0900	0.1000	0.7609	
Value added	0.2500	0.0710	0.2600	0.0000	

Table 5: Transposed input coefficients intermediates

	A	B	C		
A	0.2000	0.5000	0.1250		
B	0.0340	0.3800	0.0900		
C	0.0400	0.4000	0.1000		

Table 6: Leontief matrix

	A	B	C		
A	0.8000	-0.5000	-0.1250		
B	-0.0340	0.6200	-0.0900		
C	-0.0400	-0.4000	0.9000		

Table 7: Inverse and price model (quantities)

	A	B	C	Qv	Price
A	1.3192	1.2636	0.3096	2.5000	5.0
B	0.0864	1.8069	0.1927	0.7100	2.0
C	0.0970	0.8592	1.2105	2.6000	4.0

APPROACH B

Quantities, prices and values are known.

Table 1: Input-output table (quantities)

	A	B	C	Final demand	Output
A	4.0	6.8	2.0	7.2	20.0
B	10.0	76.0	20.0	94.0	200.0
C	2.5	18.0	5.0	24.5	50.0
Value added	5.0	14.2	13.0	0.0	32.2

Table 2: Prices

	A	B	C	Final demand	
A	5.00	5.00	5.00	5.00	
B	2.00	2.00	2.00	2.00	
C	4.00	4.00	4.00	4.00	
Value added	10.00	10.00	10.00	10.00	

Table 3: Input-output table (values)

	A	B	C	Final demand	Output
A	20.00	34.00	10.00	36.00	100.00
B	20.00	152.00	40.00	188.00	400.00
C	10.00	72.00	20.00	98.00	200.00
Value added	50.00	142.00	130.00	0.00	322.00
Input	100.00	400.00	200.00	322.00	0.00

Table 4: Input coefficients (values/values)

	A	B	C	Final demand	
A	0.2000	0.0850	0.0500	0.1118	
B	0.2000	0.3800	0.2000	0.5839	
C	0.1000	0.1800	0.1000	0.3043	
Value added	0.5000	0.3550	0.6500	0.0000	

Table 5: Transposed input coefficients intermediates

	A	B	C		
A	0.2000	0.2000	0.1000		
B	0.0850	0.3800	0.1800		
C	0.0500	0.2000	0.1000		

Table 6: Leontief matrix

	A	B	C		
A	0.8000	-0.2000	-0.1000		
B	-0.0850	0.6200	-0.1800		
C	-0.0500	-0.2000	0.9000		

Table 7: Inverse and price model (values)

	A	B	C	Qv	Price index
A	1.3192	0.5054	0.2477	0.5000	1.00
B	0.2161	1.8069	0.3854	0.3550	1.00
C	0.1213	0.4296	1.2105	0.6500	1.00

By dividing each row of the equation system by the output levels x_i, we get:

(32) $a_{11}p_1 + a_{21}p_2 + a_{31}p_3 + v_1q = p_1$
(33) $a_{12}p_1 + a_{22}p_2 + a_{32}p_3 + v_2q = p_2$
(34) $a_{13}p_1 + a_{23}p_2 + a_{33}p_3 + v_3q = p_3$

If we solve the equations system for the exogenous variable 'Wages per unit of output' v_iq, we receive the Leontief equations for the price model.

(35) $(1-a_{11})p_1 \quad -a_{12}p_2 \quad -a_{13}p_3 \quad = v_1q$ Leontief equations
(36) $-a_{21}p_1 \quad +(1-a_{22})p_2 \quad -a_{23}p_3 \quad = v_2q$
(37) $-a_{31}p_1 \quad -a_{32}p_2 \quad +(1-a_{33})p_3 \quad = v_3q$

The price model in matrix notation is defined as:

(38) $A'p + Qv = p$
(39) $p-A'p = Qv$
(40) $(I-A')p =Qv$

Table 15.12: Price model

		Agriculture	Manufacturing	Construction	Trade	Business services	Other services	Input coefficient for primary inputs	Price index
		1	2	3	4	5	6	7	8
		Transposed Leontief inverse (I-A')-1						vQ	Price index
1	Agriculture	1.0339	0.2896	0.0207	0.1269	0.1842	0.0495	0.5847	1.0000
2	Manufacturing	0.0350	1.4292	0.0191	0.1214	0.2071	0.0295	0.5171	1.0000
3	Construction	0.0100	0.3961	1.0289	0.1064	0.2503	0.0218	0.5317	1.0000
4	Trade	0.0051	0.1420	0.0211	1.1784	0.2239	0.0331	0.6327	1.0000
5	Business services	0.0030	0.0596	0.0500	0.0356	1.4126	0.0342	0.6314	1.0000
6	Other services	0.0044	0.1073	0.0250	0.0631	0.1269	1.0515	0.7690	1.0000

The solution of the linear equation system is:

(41) $p = (I - A')^{-1} Qv$

A' = transposed matrix of input coefficients for intermediates (technology matrix)
I = unit matrix
(I - A') = transposed Leontief matrix
$(I - A')^{-1}$ = transposed Leontief inverse
v = column vector of input coefficients for primary input
Q = diagonal matrix with unit factor price for primary input
p = vector of prices (price indices) for commodities

The objective of the price model is to calculate the unknown product prices (price indices) for exogenously given primary input coefficients which are weighted with the factor price.

The results for the reference country Germany are presented in Table 15.12. It should be borne in mind that for the input-output table of Germany no information on quantities and prices (see right part of Box 15.2) is available. Therefore, the input coefficients for primary input have to be weighted with a unit price index. The price model may be used to study the impact of changes in primary inputs (input coefficients, factor prices) on commodity prices. When the price model is applied, it is assumed that all conditions of perfect competition are fulfilled. Higher factor prices for primary inputs will cause higher product prices in competitive markets. In so far, the approach is able to simulate the effects of a cost push type of inflation. For example, the price model could be used to study the impact of an increase of the tax on gasoline on other product prices.

15.1.5 Central model of input-output analysis

Input-output analysis has often been used to study the impact of final demand on output (quantity model) and value added changes on prices (price model). Appropriate extensions of the input-output system allow also to evaluate the direct and indirect impact of economic policies on other economic variables such as labour, capital, energy and emissions (joint product). Most of these policy issues (labour policy, structural policy, fiscal policy) have to be analysed with macroeconomic models which provide a minimum of sectoral disaggregation.

The following extension of the input-output equation system offers multiple approaches for analysis:

(42) $Z = B(I - A)^{-1}Y$ Central equation system of input-output analysis

B = matrix of input coefficients for specific variable in economic analysis (intermediates, labour, capital, energy, emissions, etc.)

I = unit matrix

A = matrix of input coefficients for intermediates

Y = diagonal matrix for final demand

Z = matrix with results for direct and indirect requirements (intermediates, labour, capital, energy, emissions, etc.)

Matrix B includes the input coefficients of the variable under investigation (intermediates, labour, capital, energy, emissions, etc.). The diagonal matrix Y denotes exogenous final demand for goods and services. The matrix Z incorporates the results for the direct and indirect requirements (intermediates, labour, capital, energy) or joint products (emissions) for the produced goods and services. In essence, this approach would allow assessing the total (direct and indirect) primary energy requirements or carbon dioxide emissions for the production of a vehicle which can be observed at all stages of production. Corresponding calculations of the labour and capital content of commodities are also feasible. Direct contributions of final demand (for example direct emissions of carbon dioxide by private households) must be added as column vector to the results of matrix Z.

This type of analysis is based on the restrictive assumptions of static input-output models. Even if these assumptions seem to be far away from reality, it can be concluded that input-output analysis offers at least opportunities to assess the magnitude of expected effects. Table 15.13 presents a corresponding calculation for the emission of three 'bads', namely the gases carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

Rows 1-3 of Table 15.13 report the actual emissions of gases and corresponding output levels of production. In rows 5-7 coefficients have been calculated for the corresponding emission. The lowest carbon dioxide emission coefficient with 0.0127 (1.000 tons emissions per one million euro) is reported for 'Business services' in column 5. The results in row 14, however, reveal that the 'true' emission coefficient of 0.0583 for 'Business services' is much higher. The estimates in column 5 and row 14 include all direct and indirect emission of carbon dioxide which can be related to the production of one unit of output of 'Business services' at all stages of production.

As can be seen in row 17 of Table 15.13, the sector 'Agriculture' delivers goods and services in the magnitude of 15.219 billion of Euros to final demand (consumption, investment, export). The calculation reveals that in the course of production, 6.369 million tons of carbon dioxide were emitted in Germany at all stages of production to produce these agricultural commodities for final demand.

The sector 'Manufacturing' is by far the largest sector at this level of aggregation. The table reports that the manufacturing industry is directly responsible for the emission of 558.327 million tons of carbon dioxide in domestic plants (see Table 15.3). If we try to calculate how many tons of carbon dioxide were emitted at all stages of production to produce the industrial goods for final demand (619342 m EUR), then 476.044 million tons of carbon dioxide emission can be attributed to products of industry for final demand. The corresponding interpretation of results is valid for all sectors of the economy. This approach allows reallocating the emissions of carbon dioxide to the products purchased by final demand.

The total emissions of carbon dioxide are reported in Table 15.3 with 904.158 million tons. As can be seen in the same table in column (7), private households (consumption) are responsible for direct emission of 217.137 million tons carbon dioxide. The results in the last part of Table 15.13 include estimates, how emissions are related to final demand components. The direct emission of private households have to be added as a separate column vector to the matrix Z to attain in row (23) the national emission total of 904.158 million tons carbon dioxide (see Table 15.3).

Table 15.13: Emission model

No.		INPUT OF PRODUCTION ACTIVITIES						FINAL USES					Output at basic prices
		Agriculture	Manufacturing	Construction	Trade	Business services	Other services	Private consumption	Government consumption	Gross fixed capital formation	Changes in inventories	Exports	
		1	2	3	4	5	6	7	8	9	10	11	12
	EMISSIONS (1.000 tons)												
1	Carbon dioxide (CO_2)	10 448	558 327	11 194	71 269	8 792	26 990	217 137					904 158
2	Methane (CH_4)	1 534	1 160	1	4	1	1 058	136					3 894
3	Nitrous oxide (N_2O)	77	100		3		11	17					209
	OUTPUT (Millions of Euro)												
4	Output at basic prices	43 910	1 079 446	245 606	540 063	692 487	508 918						
	EMISSION COEFFICIENTS (1.000 tons per Millions of Euro)												
5	Carbon dioxide (CO_2)	0.2379	0.5172	0.0456	0.1320	0.0127	0.0530						
6	Methane (CH_4)	0.0349	0.0011	0.0000	0.0000	0.0000	0.0021						
7	Nitrous oxide (N_2O)	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000						
	INVERSE $(I-A)^{-1}$												
8	Agriculture	1.0339	0.0350	0.0100	0.0051	0.0030	0.0044						
9	Manufacturing	0.2896	1.4292	0.3961	0.1420	0.0596	0.1073						
10	Construction	0.0207	0.0191	1.0289	0.0211	0.0500	0.0250						
11	Trade	0.1269	0.1214	0.1064	1.1784	0.0356	0.0631						
12	Business services	0.1842	0.2071	0.2503	0.2239	1.4126	0.1269						
13	Other services	0.0495	0.0295	0.0218	0.0331	0.0342	1.0515						
	Direct and indirect emissions per unit of output $B(I-A)^{-1}$												
14	Carbon dioxide (CO_2)	0.4185	0.7686	0.2726	0.2357	0.0583	0.1234						
15	Methane (CH_4)	0.0365	0.0028	0.0008	0.0004	0.0002	0.0025						
16	Nitrous oxide (N_2O)	0.0018	0.0002	0.0001	0.0000	0.0000	0.0000						
	Diagonal matrix of final demand Y												
17	Agriculture	15 219											
18	Manufacturing		619 342										
19	Construction			196 063									
20	Trade				343 355								
21	Business services					268 554							
22	Other services						442 280						
	Emission content of final demand (1.000 tons) $Z = B(I-A)^{-1}Y$												
23	Carbon dioxide (CO_2)	6 369	476 044	53 437	80 932	15 654	54 586	217 137					904 158
24	Methane (CH_4)	556	1 748	162	140	65	1 086	136					3 894
25	Nitrous oxide (N_2O)	28	121	11	10	3	18	17					209

Germany 1995

This example demonstrates in an impressive way how input-output systems may be used to evaluate environmental policies (e.g. how Germany can comply with the Kyoto Agreement). At the same time, other important fields of economic analysis can be covered, such as impact of employment policies, substitution of labour and capital, productivity analysis, energy issues, environmental problems or structural policies.

15.1.6 Basic input-output models with input and output coefficients

In empirical research mainly input-output models are used which are based on input coefficients. However, there is also a family of input-output models which are based on output coefficients. These models are sometimes called Gosh-models (Gosh 1968). The models can be used to study price and cost effects or forward linkages of industries. Input coefficients reflect production functions or cost structures of activities. In contrast, output coefficients are distribution parameters for products reflecting market shares.

The use of input coefficients and output coefficients in input-output analysis is demonstrated for the four basic input-output models with input and output coefficients. The four input-output models have dual character with an underlying symmetry. Each input-output model with input coefficients has a complement with output coefficients.

(43) $a_{ij} = X_{ij}/x_j$ Input coefficients for products
(44) $w_j = W_j/x_j$ Input coefficient for value added

Input coefficients for intermediates (a_{ij}) reflect the requirements for the use of product i in industry j for one unit of output of industry j. The capital and labour requirements are defined in the same way.

(45) $b_{ij} = X_{ij}/x_i$ Output coefficients for products
(46) $d_i = Y_i/x_i$ Output coefficient for final demand

Output coefficients for intermediates (b_{ij}) identify the share of deliveries of sector i for sector j (x_{ij}) in the total output of sector i.

Model 1: Quantity model with input coefficients

(47) $Ax + y = x$
(48) $(I - A)x = y$
(49) $x = (I - A)^{-1} y$

A = Matrix of input coefficients for intermediates with $A = a_{ij}$ for i,j = 1, 2, ..., m.
I = Unit matrix
x = Column vector of output for sectors 1 to m with $x_1, x_2, \ldots, x_m$.
y = Column vector of exogenous final demand by product with $y_1, y_2, \ldots, y_m$.

Model 2: Price model with input coefficients

(50) $A'p + w = p$
(51) $(I - A')p = w$
(52) $p = (I - A')^{-1} w$

A' = Transposed matrix of input coefficients for intermediates with $A = a_{ij}$ for i,j = 1, 2, ..., m.
I = Unit matrix
x = Column vector of unit product price indexes for sectors 1 to m with $p_1, p_2, \ldots, p_m$.
w = Column vector of exogenous input coefficients for value added $w_1, w_2, \ldots, w_m$.

Model 3: Price model with output coefficients

(53) $Bp + d = p$
(54) $(I - B)p = d$
(55) $p = (I - B)^{-1} d$

B = Matrix of output coefficients for intermediates with $B = a_{ij}$ for i,j = 1, 2, ..., m.
I = Unit matrix
p = Column vector of unit product price indexes for sectors 1 to m with $p_1, p_2, \ldots, p_m$.
d = Column vector of exogenous output coefficients for final demand by product with $d_1, d_2, \ldots, d_m$.

Model 4: Quantity model with output coefficients

(56) $B'x + z = x$
(57) $(I - B')x = z$
(58) $x = (I - B')^{-1} z$

B' = Transposed matrix of output coefficients for intermediates with $A = a_{ij}$ for i,j = 1, 2, ..., m.
I = Unit matrix
x = Column vector of product output for sectors 1 to m with $x_1, x_2, \ldots, x_m$.
z = Column vector of exogenous value added by sector with $z_1, z_2, \ldots, z_m$.

The dual character of the four input-output models is presented in Box 15.3. It remains to be seen in empirical research if input coefficients or output coefficients are more stable in time and behave according to expectations. However, there are good reasons why input-output models with output coefficients are rarely used in empirical research: they lack a proper microeconomic foundation.

Box 15.3: Four basic models of input-output analysis

Input-output table

		Agriculture	Industry	Services	Final demand	Output
		1	2	3	4	6
1	Agriculture	20	34	10	36	100
2	Industry	20	152	40	188	400
3	Services	10	72	20	98	200
4	Value adde	50	142	130	0	322
5	Input	100	400	200	322	-

Input-output table

		Agriculture	Industry	Services
		1	2	3
1	Agriculture	0.2000	0.0850	0.0500
2	Industry	0.2000	0.3800	0.2000
3	Services	0.1000	0.1800	0.1000
4	Value adde	0.5000	0.3550	0.6500
5	Input	1.0000	1.0000	1.0000

Output coefficients

		Agriculture	Industry	Services	Final demand	Output
		1	2	3	4	6
1	Agriculture	0.2000	0.3400	0.1000	0.3600	1.0000
2	Industry	0.0500	0.3800	0.1000	0.4700	1.0000
3	Services	0.0500	0.3600	0.1000	0.4900	1.0000

A

0.2000	0.0850	0.0500
0.2000	0.3800	0.2000
0.1000	0.1800	0.1000

(I - A)

0.8000	-0.0850	-0.0500
-0.2000	0.6200	-0.2000
-0.1000	-0.1800	0.9000

$(I - A)^{-1}$

1.3192	0.2161	0.1213
0.5054	1.8069	0.4296
0.2477	0.3854	1.2105

B

0.2000	0.3400	0.1000
0.0500	0.3800	0.1000
0.0500	0.3600	0.1000

(I - B)

0.8000	-0.3400	-0.1000
-0.0500	0.6200	-0.1000
-0.0500	-0.3600	0.9000

$(I - B)^{-1}$

1.3192	0.8643	0.2426
0.1264	1.8069	0.2148
0.1238	0.7708	1.2105

Model 1: Quantity model with input coefficients

$(I - A)^{-1}$				y		x
1.3192	0.2161	0.1213		36		100
0.5054	1.8069	0.4296	*	188	=	400
0.2477	0.3854	1.2105		98		200

Input-output table

Intermediates	Final demand	x
Value added		
x		

Model 2: Price model with input coefficients

$(I - A')^{-1}$				w		p
1.3192	0.5054	0.2477		0.5000		1.0000
0.2161	1.8069	0.3854	*	0.3550	=	1.0000
0.1213	0.4296	1.2105		0.6500		1.0000

Input-output table

Intermediates per unit	Final demand per unit	p
Value added per unit		
p		

Model 3: Price model with output coefficients

$(I - B)^{-1}$				d		p
1.3192	0.8643	0.2426		0.3600		1.0000
0.1264	1.8069	0.2148	*	0.4700	=	1.0000
0.1238	0.7708	1.2105		0.4900		1.0000

Input-output table

Intermediates per unit	Final demand per unit	p
Value added per unit		
p		

Model 4: Quantity model with output coefficients

$(I - B')^{-1}$				z		x
1.3192	0.1264	0.1238		50		100
0.8643	1.8069	0.7708	*	142	=	400
0.2426	0.2148	1.2105		130		200

Input-output table

Intermediates	Final demand	x
Value added		
x		

Input-output models with input coefficients are well established in economic analysis. At best, such models reflect the cost structure of industries and input structure of final demand components. However, it is the rigidity of the underlying Leontief production functions which is an obstacle to many applications.

15.1.7 Indicators and multipliers

In the general neoclassical microeconomic approach, the production functions relate the amounts of inputs used by a sector to the maximum amount of output that could be produced by that sector with those inputs.

(59) $x_j = f(x_{ij}, L_j, C_j)$ Production function

x_j = output of sector j (products)
x_{ij} = interindustry flow (goods, services) from sector i to sector j (intermediates)
L_j = labour requirements of sector j
C_j = capital requirements of sector j
f = technology

Indicators

In input-output analysis a fundamental assumption is that for a given period the interindustry flows of products (x_{ij}) from sector i to sector j and primary inputs (L, C) depend on the total output of sector j (x_j). If we assume constant returns to scale and fixed relations of all inputs, a set of technical input coefficients reflects the technology. In most productions not only different products but also different skills of labour and different types of capital goods are required. Therefore, the set of input coefficients in a broader notation of matrix A encompass input coefficients for products (intermediates), capital, and labour (primary inputs).

(60) $a_{ij} = z_{ij}/x_j$ Technical input coefficients

a_{ij} = input coefficient
z_{ij} = input of type i in sector j (products, capital, labour)
x_j = output of sector j (product)

Using the definitions of the technical input coefficients, production can be specified in the following form:

(61) $x_j = \min(z_{1j}/a_{1j}, z_{2j}/a_{2j}, \ldots, z_{nj}/a_{nj})$ Leontief production function

A number of input indicators for various branches have been summarised in Table 15.14. They represent input requirements for products (intermediates), labour, capital, and energy. The last set of coefficients has a different character. In each production and consumer activity, certain pollutants are emitted as joint products (bads). In the last two rows, the corresponding emission coefficients for carbon dioxide and nitrous oxide are reported for the six aggregate branches.

Column-wise the coefficients have the following interpretation: For agriculture: 50.66 percent of all inputs were intermediates, among them 41.53 percent from domestic production and 6.67 percent imported from foreign countries. Value added (consumption of fixed capital, other net taxes on production, wages and salaries, operating surplus) contributed to the rest of 49.34 percent. 148.000 EUR were invested per one million EUR of output. Most of the gross investment (GFCF) was required for the replacement of capital goods. The capital intensity (capital equipment per unit of output) of agriculture was very high (5.673 Mill. Euros). Also, the labour intensity was very high (25.0 Persons/Mill. Euro) indicating a low productivity level. Compared to other branches (except 'Manufacturing'), 'Agriculture' is an energy intensive sector.

Table 15.14: Input indicators for branches

		INPUT OF PRODUCTION ACTIVITIES					
		Agriculture	Manufacturing	Construction	Trade	Business services	Other services
		1	2	3	4	5	6
		DOMESTIC PRODUCTION					
1	Domestic goods and services	0.4153	0.4829	0.4683	0.3673	0.3686	0.2310
		IMPORT					
2	Imported goods and services	0.0667	0.1452	0.0547	0.0406	0.0193	0.0271
		SUPPLY					
3	Intermediate consumption	0.5066	0.6341	0.5292	0.4234	0.4001	0.2828
		INCOME					
4	Compensation of employees	0.2137	0.2746	0.3209	0.3971	0.1802	0.5364
5	Other net taxes on production	-0.0458	0.0013	0.0039	0.0051	0.0086	-0.0169
6	Consumption of fixed capital	0.1793	0.0591	0.0239	0.0761	0.1424	0.0968
7	Operating surplus, net	0.1463	0.0309	0.1221	0.0983	0.2687	0.1010
8	Value added at basic prices	0.4934	0.3659	0.4708	0.5766	0.5999	0.7172
		GROSS FIXED CAPITAL FORMATION (Millions of Euro)					
9	Machinery	0.1018	0.0507	0.0270	0.0593	0.0595	0.0423
10	Buildings	0.0463	0.0173	0.0096	0.0413	0.2452	0.1078
11	Total	0.1480	0.0680	0.0366	0.1006	0.3047	0.1501
		CAPITAL STOCK (Millions of Euro)					
12	Machinery	1.9665	0.6733	0.2370	0.6340	0.4517	0.3680
13	Buildings	3.7065	0.5229	0.2022	1.0219	6.5422	3.3085
14	Total	5.6729	1.1962	0.4392	1.6559	6.9939	3.6765

	EMPLOYMENT (1.000 persons)						
15	Wage and salary earners	0.0110	0.0074	0.0118	0.0148	0.0053	0.0188
16	Self-employed	0.0140	0.0003	0.0014	0.0024	0.0009	0.0013
17	Total	0.0250	0.0078	0.0132	0.0171	0.0061	0.0201
	ENERGY (Terajoule)						
18	Coal	0.0322	1.8810	0.0070	0.0035	0.0001	0.0058
19	Lignite	0.0000	1.6762	0.0000	0.0001	0.0002	0.0054
20	Crude oil	0.0000	4.0762	0.0000	0.0000	0.0000	0.0000
21	Natural gas	0.2031	1.6359	0.0255	0.1927	0.0648	0.2646
22	Nuclear fuels	0.0000	1.5581	0.0000	0.0000	0.0000	0.0000
23	Water power	0.0000	0.1620	0.0000	0.0028	0.0009	0.0031
24	Briquettes	0.1578	0.0150	0.0329	0.0004	0.0002	0.0147
25	Coke	0.0226	0.4133	0.0035	0.0023	0.0001	0.0007
26	Petroleum products	2.9433	1.9594	1.0746	2.3481	0.1233	0.5060
27	Electricity	0.4442	0.9701	0.0124	0.3198	0.0623	0.2288
28	Produced gas	0.0127	0.5262	0.0032	0.0032	0.0006	0.0054
29	Steam, hot water	0.0278	0.0754	0.0083	0.0562	0.0191	0.1305
30	Total	3.8437	14.9487	1.1676	2.9290	0.2717	1.1650
	EMISSIONS (1.000 tons)						
31	Carbon dioxide (CO_2)	0.2379	0.5172	0.0456	0.1320	0.0127	0.0530
32	Methane (CH_4)	0.0349	0.0011	0.0000	0.0000	0.0000	0.0021
33	Nitrous oxide (N_2O)	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000
34	Sulfur dioxide (SO_2)	0.0003	0.0016	0.0001	0.0001	0.0000	0.0000
35	Nitrogen oxides (NO_x)	0.0014	0.0007	0.0003	0.0008	0.0000	0.0001
36	Carbon monoxide (CO)	0.0010	0.0015	0.0003	0.0008	0.0001	0.0004
37	Organic compounds (NMVOC)	0.0004	0.0011	0.0001	0.0002	0.0000	0.0003
38	Dust particles	0.0013	0.0002	0.0000	0.0001	0.0000	0.0000
39	Total	0.2790	0.5234	0.0464	0.1340	0.0129	0.0560
	GLOBAL WARMING AND ACID DEPOSITION (1.000 tons)						
40	Greenhouse gases	1.5127	0.5687	0.0462	0.1339	0.0129	0.1036
41	Acid deposition	0.0013	0.0020	0.0003	0.0007	0.0000	0.0001
	WASTE (1.000 tons)						
41	Waste	0.0018	0.1410	0.6267	0.0164	0.0164	0.0214
42	Sewage	0.0008	0.0370	0.0001	0.0003	0.0003	0.0004

Germany 1995

Multipliers

Three of the most frequently used types of multipliers in input-output analysis are those that estimate the effects of the exogenous changes of final demand (consumption, investment, exports) on

- outputs of the sectors in the economy,
- value added and income earned by the households, and
- employment that is expected to be generated by the new activity levels.

Output multipliers

An output multiplier for a sector j is defined as the total value of production in all sectors of the economy that is necessary at all stages of production in order to produce one unit of product j for final demand. The output multiplier in Table 15.15 corresponds to the column sum of the inverse (see Table 15.10).

Table 15.15: Output multipliers

		Agriculture	Manufacturing	Construction	Trade	Business services	Other services
		1	2	3	4	5	6
1	Agriculture	1.0339	0.0350	0.0100	0.0051	0.0030	0.0044
2	Manufacturing	0.2896	1.4292	0.3961	0.1420	0.0596	0.1073
3	Construction	0.0207	0.0191	1.0289	0.0211	0.0500	0.0250
4	Trade	0.1269	0.1214	0.1064	1.1784	0.0356	0.0631
5	Business services	0.1842	0.2071	0.2503	0.2239	1.4126	0.1269
6	Other services	0.0495	0.0295	0.0218	0.0331	0.0342	1.0515
8	Total	1.7048	1.8413	1.8136	1.6035	1.5951	1.3782

If a government agency, for example, were trying to determine in which sector of the economy to spend an additional Euro, a comparison of output multipliers would indicate where this investment has the greatest impact in terms of total Euro value of output (cumulative revenues) generated throughout the economy. In our case it would be the sector "Manufacturing" with an output multiplier of $O_4 = 1.8413$. If we represent the elements of the inverse $(I - A)^{-1}$ as α_{ij} , then the output multiplier is defined as:

(62) $O_j = \sum_{i=1}^{n} \alpha_{ij}$ Output multiplier

The output multiplier (cumulative revenues) in row 8 of Table 15.13 represents for each industry one unit of final demand and the direct and indirect requirements for domestic intermediates. Multipliers of this sort may overstate the effect on the economy in question if some sectors are operating at full capacity and a substitution of input takes place.

Income multipliers

Income multipliers attempt to identify the impacts of final demand changes on income received by households (labour supply). The central equation (42) of the static input-output models is used to calculate the direct and indirect requirements for wages which are incorporated in one unit of output for final demand. This calculation is equivalent to an assessment of the wage content of products.

(63) $Z = B(I-A)^{-1}$ Direct and indirect requirements for wages

B = vector of input coefficients for wages
I = unit matrix
A = matrix of input coefficients for intermediates
Z = vector with results for direct and indirect requirements for wages

Table 15.16: Multipliers for products

No.		INPUT OF PRODUCTION ACTIVITIES					
		Agriculture	Manufacturing	Construction	Trade	Business services	Other services
		1	2	3	4	5	6
	DOMESTIC PRODUCTION						
1	Final demand	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	Domestic intermediates	0.7048	0.8413	0.8136	0.6035	0.5951	0.3782
3	Output	1.7048	1.8413	1.8136	1.6035	1.5951	1.3782
	IMPORT						
4	Imported goods and services	0.1221	0.2206	0.1242	0.0752	0.0412	0.0507
	SUPPLY						
5	Intermediate consumption	0.8598	1.0766	0.9522	0.7016	0.6557	0.4583
	INCOME						
6	Compensation of employees	0.4172	0.5075	0.5402	0.5729	0.3202	0.6504
7	Other net taxes on production	-0.0455	0.0023	0.0064	0.0074	0.0119	-0.0163
8	Consumption of fixed capital	0.2436	0.1328	0.0956	0.1346	0.2124	0.1324
9	Operating surplus, net	0.2297	0.1221	0.2192	0.1871	0.3949	0.1535
10	Value added at basic prices	0.8450	0.7647	0.8615	0.9019	0.9393	0.9199
	GROSS FIXED CAPITAL FORMATION (Millions of Euro)						
9	Machinery	0.1410	0.0973	0.0710	0.0929	0.0923	0.0623
10	Buildings	0.1088	0.0856	0.0853	0.1100	0.3531	0.1494
11	Total	0.2498	0.1829	0.1563	0.2029	0.4454	0.2118
	CAPITAL STOCK (Millions of Euro)						
12	Machinery	2.4149	1.2171	0.7189	0.9710	0.7312	0.5712
13	Buildings	5.4862	2.4577	2.2709	2.8758	9.4434	4.4510
14	Total	7.9011	3.6748	2.9897	3.8468	10.1746	5.0221
	EMPLOYMENT (1.000 persons)						
15	Wage and salary earners	0.0175	0.0147	0.0185	0.0206	0.0097	0.0225
16	Self-employed	0.0151	0.0015	0.0022	0.0032	0.0015	0.0017
17	Total	0.0326	0.0162	0.0207	0.0237	0.0112	0.0242
	ENERGY (Terajoule)						
18	Coal	0.5790	2.6901	0.7532	0.2717	0.1131	0.2086
19	Lignite	0.4858	2.3957	0.6642	0.2383	0.1004	0.1857
20	Crude oil	1.1806	5.8254	1.6147	0.5787	0.2431	0.4375
21	Natural gas	0.7338	2.3902	0.7188	0.4842	0.2070	0.4757
22	Nuclear fuels	0.4513	2.2268	0.6172	0.2212	0.0929	0.1673
23	Water power	0.0476	0.2321	0.0648	0.0266	0.0111	0.0210
24	Briquettes	0.1690	0.0281	0.0418	0.0047	0.0038	0.0186
25	Coke	0.1435	0.5919	0.1679	0.0616	0.0251	0.0454
26	Petroleum products	3.9785	3.2494	2.2031	3.1271	0.4545	0.9461
27	Electricity	0.8039	1.4607	0.4561	0.5386	0.1670	0.3750
28	Produced gas	0.1664	0.7531	0.2125	0.0789	0.0328	0.0625
29	Steam, hot water	0.0679	0.1236	0.0523	0.0859	0.0385	0.1516
30	Total	8.8073	21.9671	7.5666	5.7175	1.4894	3.0952

	EMISSIONS (1.000 tons)						
31	Carbon dioxide (CO_2)	0.4185	0.7686	0.2726	0.2357	0.0583	0.1234
32	Methane (CH_4)	0.0365	0.0028	0.0008	0.0004	0.0002	0.0025
33	Nitrous oxide (N_2O)	0.0018	0.0002	0.0001	0.0000	0.0000	0.0000
34	Sulfur dioxide (SO_2)	0.0008	0.0023	0.0007	0.0003	0.0001	0.0002
35	Nitrogen oxides (NO_x)	0.0018	0.0011	0.0006	0.0011	0.0001	0.0003
36	Carbon monoxide (CO)	0.0016	0.0023	0.0011	0.0012	0.0004	0.0006
37	Organic compounds (NMVOC)	0.0008	0.0017	0.0005	0.0004	0.0001	0.0004
38	Dust particles	0.0014	0.0003	0.0001	0.0001	0.0000	0.0000
39	Total	0.4632	0.7793	0.2766	0.2393	0.0593	0.1275
	GLOBAL WARMING AND ACID DEPOSITION (1.000 tons)						
40	Greenhouse gases	1.7541	0.8886	0.3077	0.2535	0.0674	0.1879
41	Acid deposition	0.0020	0.0031	0.0012	0.0011	0.0002	0.0004
	WASTE (1.000 tons)						
41	Waste	0.0618	0.2196	0.7071	0.0569	0.0643	0.0564
42	Sewage	0.0116	0.0530	0.0149	0.0057	0.0027	0.0045

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Table 15.16 summarizes various multipliers for products which are delivered to final demand. In our numerical example, the sector 'Agriculture' has a small direct input coefficients for wages ($b_1 = 0.2137$ in Table 15.14). Today, most of the working population in agriculture are self-employed. However, if we calculate the income multiplier for wages (direct and indirect wage requirements per unit of output) for this sector ($z_1 = 0.4172$ in Table 15.16) we can verify that the 'wage content' of agricultural products is threefold. Obviously the intermediates inputs of agriculture incorporate a good amount of wages. As expected 'Other services' have the highest direct ($b_6 = 0.5364$) and direct and indirect ($b_6 = 0{,}6504$) wage requirements. This general approach allows to asses the wage, labour, capital or energy content of the various components of final demand.

Employment multipliers

When employment multipliers are calculated, the major difference to the calculation of the wage content of products is that this time physical labour input coefficients are used instead of monetary labour input coefficients.

(64) $Z = E(I - A)^{-1}$ Direct and indirect requirements for labour

E = matrix of input coefficients for labour (1.000 persons per millions of DEM of output)
Z = matrix with results for direct and indirect requirements for labour (persons)

For each sector the employment multipliers represent jobs created per dollar of additional final demand. The labour intensive sector 'Agriculture' has the highest employment multiplier ($z_1 = 0.0326$). If the final demand for agricultural products were increased by one million euros, 32.6 positions for employees would be created in this sector. However, the largest difference between direct employment coefficients and employment multipliers (direct and indirect employment) is observed in 'Manufacturing'.

Capital multipliers

The satellite systems in Table 15.3 (Extended input-output table) include information on labour and capital which is required for the production of the various sectors. The matrix for labour distinguishes in two rows wage and salary earners and self-employed while the matrix for the capital stock provides data for machinery and buildings. This data base allows not only to assess the labour and capital content of products but also to study the direct and indirect substitution of labour and capital, provided that a time series of input-output tables with the corresponding satellite systems are available.

This time, monetary input coefficients for capital are used to calculate the capital content of products with the following equation:

(65) $Z = C(I - A)^{-1}$ Direct and indirect requirements for capital

C = matrix of input coefficients for capital requirements per unit of output
Z = matrix with results for direct and indirect requirements of capital

The calculation reveals that the highest capital multiplier (capital intensity) is observed in 'Business services'. The direct capital requirements in this sector are reported with c_1 = 6.9939 in Table 15.14. The capital multipliers in Table 15.16 reflect the direct and indirect capital requirements on all stages of production. To produce one million euros of 'Business services' for final demand 10.175 millions of euros capital (buildings, machinery) are required (z_1 = 10.1746) on all stages of production.

Primary input content of final demand

The multipliers in Table 15.16 allow to assess the primary input content of final demand by product and by category. The results are presented in Table 15.17 for the primary input content of final demand by product and in Table 15.18 for the primary input content of final demand by category.

For the various products of final demand, the multipliers for primary inputs $B(I - A)^{-1}$ are multiplied with a diagonal matrix of final demand total for products.

Table 15.17: Primary input content of final demand by product

No.		Agriculture	Manufacturing	Construction	Trade	Business services	Other services	Total
		1	2	3	4	5	6	7
	FINAL DEMAND (Millions of Euro)							
1	Total	15 219	619 342	196 063	343 355	268 554	442 280	1 884 813
	PRIMARY INPUT CONTENT OF FNAL DEMAND							
	IMPORT (Millions of Euro)							
3	Imported goods and services	1 859	136 614	24 346	25 820	11 075	22 430	222 143
	SUPPLY (Millions of Euro)							
4	Total	13 086	666 792	186 684	240 899	176 097	202 712	1 486 270
	INCOME (Millions of Euro)							
5	Compensation of employees	6 350	314 309	105 913	196 698	85 980	287 651	996 900
6	Other net taxes on production	- 693	1 422	1 261	2 541	3 188	- 7 219	500
7	Consumption of fixed capital	3 708	82 218	18 744	46 203	57 048	58 548	266 470
8	Operating surplus, net	3 495	75 653	42 983	64 234	106 046	67 879	360 290
9	Value added at basic prices	12 860	473 601	168 901	309 677	252 262	406 859	1 624 160
	INVESTMENT (Millions of Euro)							
10	Machinery	2 146	60 257	13 924	31 890	24 785	27 569	160 571
11	Buildings	1 656	52 996	16 721	37 761	94 840	66 084	270 057
12	Total	3 802	113 253	30 645	69 651	119 625	93 653	430 628
	CAPITAL STOCK (Millions of Euro)							
13	Machinery	36 752	753 798	140 943	333 406	196 366	252 609	1 713 873
14	Buildings	83 495	1 522 129	445 235	987 408	2 536 056	1 968 582	7 542 906
15	Total	120 247	2 275 927	586 178	1 320 814	2 732 421	2 221 192	9 256 779
	EMPLOYMENT (1.000 Persons)							
16	Wage and salary earners	267	9 095	3 626	7 062	2 601	9 945	32 596
17	Self-employed	229	918	429	1 086	401	768	3 832
18	Total	497	10 013	4 055	8 149	3 002	10 713	36 428

	ENERGY (Terajoule)							
19	Coal	8 813	1 666 095	147 670	93 275	30 387	92 264	2 038 502
20	Lignite	7 394	1 483 762	130 217	81 826	26 973	82 112	1 812 284
21	Crude oil	17 968	3 607 945	316 581	198 702	65 277	193 518	4 399 992
22	Natural gas	11 168	1 480 356	140 923	166 246	55 578	210 413	2 064 686
23	Nuclear fuels	6 868	1 379 131	121 013	75 954	24 952	73 972	1 681 890
24	Water power	724	143 749	12 703	9 127	2 986	9 273	178 563
25	Briquettes	2 572	17 410	8 201	1 602	1 025	8 248	39 058
26	Coke	2 184	366 586	32 915	21 161	6 754	20 091	449 690
27	Petroleum products	60 549	2 012 467	431 952	1 073 713	122 066	418 453	4 119 201
28	Electricity	12 234	904 674	89 428	184 936	44 838	165 877	1 401 988
29	Produced gas	2 532	466 447	41 663	27 080	8 799	27 656	574 177
30	Steam, hot water	1 033	76 533	10 262	29 495	10 342	67 048	194 713
31	Total	134 038	13 605 157	1 483 528	1 963 117	399 979	1 368 925	18 954 744
	EMISSIONS (1.000 Tons)							
32	Carbon dioxide (CO_2)	6 369	476 044	53 437	80 932	15 654	54 586	687 021
33	Methane (CH_4)	556	1 748	162	140	65	1 086	3 758
34	Nitrous oxide (N_2O)	28	121	11	10	3	18	193
35	Sulfur dioxide (SO_2)	12	1 414	141	116	30	101	1 814
36	Nitrogen oxides (NO_x)	27	695	127	380	37	115	1 381
37	Carbon monoxide (CO)	24	1 437	214	418	97	279	2 469
38	Organic compounds (NMVOC)	13	1 024	108	137	32	192	1 504
39	Dust particles	21	169	22	36	5	18	271
40	Total	7 049	482 651	54 222	82 168	15 923	56 397	698 410
	DEPOSITIONS (1.000 Tons)							
41	Greenhouse gases	26 696	550 322	60 331	87 054	18 088	83 126	825 617
42	Acid deposition	30	1 900	230	382	56	182	2 780
	WASTE (1.000 Tons)							
43	Waste	940	135 981	138 630	19 547	17 258	24 950	337 307
44	Sewage	177	32 806	2 926	1 961	722	1 971	40 562

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Table 15.18: Primary input content of final demand by category

No.		Private consumption	Government consumption	Gross fixed capital formation	Changes in inventories	Exports	Total
		1	2	3	4	5	6
	FINAL DEMAND (Millions of Euro)						
1	Total	813 673	350 150	334 144	7 553	379 293	1 884 813
	PRIMARY OF FINAL DEMAND						
	IMPORT (Millions of Euro)						
3	Imported goods and services	80 292	19 507	46 878	1 667	73 800	222 143
	SUPPLY (Millions of Euro)						
4	Total	608 336	171 437	315 099	8 133	383 265	1 486 270
	INCOME (Millions of Euro)						
5	Compensation of employees	406 753	222 051	171 356	3 834	192 907	996 900
6	Other net taxes on production	2 684	- 4 935	1 714	18	1 020	500
7	Consumption of fixed capital	126 385	47 165	39 990	1 002	51 927	266 470
8	Operating surplus, net	180 462	56 402	68 991	922	53 513	360 290
9	Value added at basic prices	716 284	320 682	282 052	5 775	299 367	1 624 160

	INVESTMENT (Millions of Euro)						
10	Machinery	73 002	22 848	27 268	735	36 719	160 571
11	Buildings	141 498	53 239	37 235	646	37 439	270 057
12	Total	214 501	76 087	64 503	1 381	74 157	430 628
	CAPITAL STOCK (Millions of Euro)						
13	Machinery	750 877	212 681	294 360	9 186	446 770	1 713 873
14	Buildings	3 876 017	1 568 769	1 017 712	18 545	1 061 864	7 542 906
15	Total	4 626 893	1 781 450	1 312 072	27 730	1 508 635	9 256 779
	EMPLOYMENT (1.000 Persons)						
16	Wage and salary earners	13 432	7 649	5 605	111	5 800	32 596
17	Self-employed	1 810	623	696	11	691	3 832
18	Total	15 242	8 272	6 301	122	6 491	36 428
	ENERGY (Terajoule)						
19	Coal	662 092	94 656	400 759	20 331	860 664	2 038 502
20	Lignite	588 298	84 201	355 487	18 106	766 192	1 812 284
21	Crude oil	1 428 390	200 312	864 258	44 027	1 863 005	4 399 992
22	Natural gas	713 351	180 618	373 889	18 063	778 765	2 064 686
23	Nuclear fuels	546 000	76 569	330 361	16 829	712 131	1 681 890
24	Water power	58 598	9 165	34 629	1 754	74 418	178 563
25	Briquettes	11 448	6 293	11 345	211	9 761	39 058
26	Coke	146 321	20 706	88 672	4 473	189 518	449 690
27	Petroleum products	1 738 081	376 528	793 401	24 538	1 186 653	4 119 201
28	Electricity	523 245	140 827	237 731	11 037	489 147	1 401 988
29	Produced gas	186 890	27 860	112 612	5 692	241 124	574 177
30	Steam, hot water	74 751	50 742	24 471	934	43 816	194 713
31	Total	6 677 464	1 268 475	3 627 616	165 997	7 215 193	18 954 744
	EMISSIONS (1.000 Tons)						
32	Carbon dioxide (CO_2)	247 357	49 732	129 496	5 808	254 629	687 021
33	Methane (CH_4)	1 327	812	548	21	1 049	3 758
34	Nitrous oxide (N_2O)	70	16	35	1	70	193
35	Sulfur dioxide (SO_2)	603	98	358	17	737	1 814
36	Nitrogen oxides (NO_x)	598	109	253	8	412	1 381
37	Carbon monoxide (CO)	957	241	457	18	796	2 469
38	Organic compounds (NMVOC)	520	159	270	12	542	1 504
39	Dust particles	103	17	53	2	96	271
40	Total	251 537	51 184	131 471	5 888	258 331	698 410
	DEPOSITIONS (1.000 Tons)						
41	Greenhouse gases	297 019	71 612	151 958	6 706	298 321	825 617
42	Acid deposition	1 022	175	535	23	1 025	2 780
	WASTE (1.000 Tons)						
43	Waste	82 290	21 722	158 810	1 659	72 825	337 307
44	Sewage	13 277	1 984	7 930	400	16 971	40 562

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(66) $Z = B(I - A)^{-1}\, Y$ Direct and indirect requirements for primary inputs

B = matrix of input coefficients for primary input
I = unit matrix
A = matrix of input coefficients for intermediates
Y = Diagonal matrix for final demand by product
Z = matrix with results for direct and indirect requirements for primary inputs

The multipliers for primary inputs B(I-A)-1 are multiplied with a matrix of final demand by category to assess the direct and indirect primary input requirements for the various categories of final demand (consumption, investment, exports).

(67) $Z = B(I - A)^{-1}\, Y$ Direct and indirect requirements for primary inputs

B = matrix of input coefficients for primary input
Y = matrix of final demand by category
Z = matrix with results for direct and indirect requirements for primary inputs

Interindustrial Linkage Analysis

In the framework of input-output analysis, production by a particular sector has two kinds of effects on other sectors in the economy. If a sector j increases its output, more inputs (purchases) are required including more intermediates from other sectors. The term ‘backward linkage’ is used to indicate the interconnection of a particular sector to other sectors from which it purchases inputs (demand side). On the other hand, increased output of sector j indicates that additional amounts of products are available to be used as inputs by other sectors. There will be increased supplies from sector j for sectors which use product j in their production (supply side). The term ‘forward linkage’ is used to indicate this interconnection of a particular sector to those to which it sells its output. Many definitions of linkage measures have been proposed and questions on the identification of key sectors in developing countries have been raised which are summarised in McGilvray (1977) and Hewings (1982).

Table 15.19: Backward linkages

		Agriculture	Manufacturing	Construction	Trade	Business services	Other services
		1	2	3	4	5	6
				INPUT COEFFICIENTS			
1	Agriculture	0.0258	0.0236	0.0000	0.0011	0.0010	0.0015
2	Manufacturing	0.1806	0.2822	0.2613	0.0761	0.0173	0.0597
3	Construction	0.0097	0.0068	0.0158	0.0098	0.0339	0.0180
4	Trade	0.0811	0.0674	0.0578	0.1378	0.0156	0.0413
5	Business services	0.0828	0.0890	0.1263	0.1218	0.2790	0.0672
6	Other services	0.0353	0.0139	0.0071	0.0208	0.0217	0.0434
7	Total	0.4153	0.4829	0.4683	0.3673	0.3686	0.2310
				INVERSE			
1	Agriculture	1.0339	0.0350	0.0100	0.0051	0.0030	0.0044
2	Manufacturing	0.2896	1.4292	0.3961	0.1420	0.0596	0.1073
3	Construction	0.0207	0.0191	1.0289	0.0211	0.0500	0.0250
4	Trade	0.1269	0.1214	0.1064	1.1784	0.0356	0.0631
5	Business services	0.1842	0.2071	0.2503	0.2239	1.4126	0.1269
6	Other services	0.0495	0.0295	0.0218	0.0331	0.0342	1.0515
7	Total	1.7048	1.8413	1.8136	1.6035	1.5951	1.3782

In its simplest form, the strength of the backward linkage of a sector j is given by the column sum of the direct input coefficients. A more useful and comprehensive measure is provided by the column sums of the inverse, which reflects the direct and indirect effects. In our assessment in Table 15.19 the sector 'Manufacturing' has the most profound backward linkages ($b_j = 1.8413$).

Backward linkages are demand-oriented. The sector 'Construction' requires inputs from many other sectors. Thus, strong backward linkages must be expected for this sector. Forward linkages are supply oriented. The sector 'Electricity' supplies electricity to all other sectors. This sector is expected to have strong forward linkages (many clients), but weak backward linkages (few inputs). Again the column totals of the direct output coefficients and the inverse output coefficients reflect the intensity of forward linkages. In the example in Table 15.20, the sector 'Agriculture' has the strongest forward linkages ($f_j = 2.1126$).

Table 15.20: Forward linkages

		Agriculture	Manufacturing	Construction	Trade	Business services	Other services	Total
		1	2	3	4	5	6	7
				OUTPUT COEFFICIENTS				
1	Agriculture	0.0258	0.5803	0.0000	0.0138	0.0162	0.0174	0.6534
2	Manufacturing	0.0073	0.2822	0.0594	0.0381	0.0111	0.0281	0.4262
3	Construction	0.0017	0.0299	0.0158	0.0216	0.0955	0.0373	0.2017
4	Trade	0.0066	0.1346	0.0263	0.1378	0.0201	0.0389	0.3642
5	Business services	0.0053	0.1388	0.0448	0.0950	0.2790	0.0494	0.6122
6	Other services	0.0030	0.0294	0.0034	0.0221	0.0296	0.0434	0.1309
				INVERSE				
1	Agriculture	1.0339	0.8611	0.0561	0.0626	0.0477	0.0513	2.1126
2	Manufacturing	0.0118	1.4292	0.0901	0.0710	0.0383	0.0506	1.6910
3	Construction	0.0037	0.0839	1.0289	0.0464	0.1411	0.0518	1.3558
4	Trade	0.0103	0.2426	0.0484	1.1784	0.0456	0.0595	1.5848
5	Business services	0.0117	0.3228	0.0888	0.1746	1.4126	0.0932	2.1037
6	Other services	0.0043	0.0626	0.0105	0.0351	0.0466	1.0515	1.2106

When linkages are measured in order to compare the structure of production or technologies between countries, the matrix of input coefficients for intermediates should be derived from total interindustry transactions regardless whether intermediates have domestic or foreign origin. On the other hand, if linkages are used to identify key sectors with high multipliers in a particular economy, only domestic intermediates should be used to assess the forward and backward linkages in the national context.

Examples for multiplier and impact analysis

The following examples of multiplier and impact analysis demonstrate that applications of input-output analysis are gaining in importance. The main reason is that applied economic analysis must deal with the integration of world economies and the globalisation of markets in a sensible way. Input-output analysis is a promising approach for this purpose.

Export dependency of employment is high

In our example in Table 15.21 approximately 17.8 percent of all employees were directly or indirectly engaged for the production of exports (see column (5) in Table 15.21). The share of exports in total final demand (consumption, investment, exports) in value terms was 20.1 percent, roughly the same magnitude.

Table 15.21: Final demand and attributed employment

		Private consumption	Government consumption	Gross fixed capital formation	Changes in inventories	Exports	Total
		1	2	3	4	5	6
				TOTALS			
1	Final demand (Mio. Euro)	813 673	350 150	334 144	7 553	379 293	1 884 813
2	Employees (1.000 Persons)	15 242	8 272	6 301	122	6 491	36 428
				SHARES (in percent)			
3	Final demand	43.2	18.6	17.7	0.4	20.1	100.0
4	Employees	41.8	22.7	17.3	0.3	17.8	100.0

Private consumption is the largest employer

With a share of 43.2 percent in total final demand, private consumption is the largest category of final demand. 41.8 percent of all employees work at all stages of production for the production of private consumption (goods and services).

Investment is low

The share of gross fixed capital formation in total final demand of 17.7 percent is low by international standards. 17.3 percent of all employees work for sectors which produce investment goods (construction, machinery, etc.). The major part of the gross fixed capital formation is invested for the replacement of capital goods.

Government services are labour intensive

Government consumption has a share of 18.6 percent in total final demand. As government services (public services, defence, public order, education, health, social security, welfare affairs, cultural services, etc.) are labour intensive services, it must be expected that the direct and indirect share of government consumption in employment is high. Purchases of intermediates and the wage and salary bill for government employees contribute to a high effect in employment. 22.7 percent of all employees are directly or indirectly employed for government consumption.

Table 15.22: Private consumption and employment

		Agricul-ture	Manufac-turing	Construc-tion	Trade	Business services	Other services	Final demand (Millions of Euro)	Output (Millions of. Euro)	Labour coeffi-cients	Employ-ees (1.000 persons)
		1	2	3	4	5	6	7	8	9	10
	BASE CASE			Inverse $(I-A)^{-1}$				y	x		
1	Agriculture	1.0339	0.0350	0.0100	0.0051	0.0030	0.0044	15 632	44 968	0.0250	1 122
2	Manufacturing	0.2896	1.4292	0.3961	0.1420	0.0596	0.1073	627 202	1 100 629	0.0078	8 545
3	Construction	0.0207	0.0191	1.0289	0.0211	0.0500	0.0250	203 805	255 493	0.0132	3 366
4	Trade	0.1269	0.1214	0.1064	1.1784	0.0356	0.0631	349 578	552 688	0.0171	9 467
5	Business services	0.1842	0.2071	0.2503	0.2239	1.4126	0.1269	275 797	714 192	0.0061	4 391
6	Other services	0.0495	0.0295	0.0218	0.0331	0.0342	1.0515	493 034	563 160	0.0201	11 294
7	Total							1 965 048	3 231 130		38 187
	EMPLOYMENT PROGRAMME			Inverse $(I-A)^{-1}$				y	x		
8	Agriculture	1.0339	0.0350	0.0100	0.0051	0.0030	0.0044	15 734	45 189	0.0250	1 128
9	Manufacturing	0.2896	1.4292	0.3961	0.1420	0.0596	0.1073	629 605	1 104 899	0.0078	8 579
10	Construction	0.0207	0.0191	1.0289	0.0211	0.0500	0.0250	203 847	255 823	0.0132	3 371
11	Trade	0.1269	0.1214	0.1064	1.1784	0.0356	0.0631	352 927	557 129	0.0171	9 543
12	Business services	0.1842	0.2071	0.2503	0.2239	1.4126	0.1269	278 443	719 391	0.0061	4 423
13	Other services	0.0495	0.0295	0.0218	0.0331	0.0342	1.0515	494 493	564 973	0.0201	11 330
14	Total							1 975 048	3 247 405		38 374
	DIFFERENCE							y	x		
15	Total							10 000	16 274		187

Employment programmes have different impacts

One of the most prominent applications of input-output analysis is the assessment of government policy on employment. If, for instance, private consumption increases by 10 billion euros, employment would increase by 187.000 positions (Table 15.22). However, if the increase of final demand by 10 billion euros is allocated for government consumption, the impact on employment would be larger (240.000 persons). In case the employment programme were implemented for investment, employment would increase by 189.000 positions and by 171.000 positions for exports. More or less, the same impact on employment can be expected for private consumption, investment and exports, but not for government services.

Price increases of primary inputs induce inflation

Price increases of primary inputs (imports, capital, and labour) threaten the price stability in many countries. In the following calculation it is assumed that the prices of all primary inputs increase in manufacturing. In Table 15.23 the impact on product prices has been calculated with the price model of input-output analysis. One fundamental feature of the price model is the assumption that firms have the market power to fully reflect rising costs of primary inputs in their product prices. If prices for primary inputs in manufacturing increase by 10 percent, it is expected that the prices of manufactured goods will increase by 7.4 percent, prices of construction by 2.1 percent and prices of agricultural goods by 1.5 percent.

Table 15.23: Price increase and inflation

		Agriculture	Manufac-turing	Construc-tion	Trade	Business services	Other services	Input coefficient for primary inputs	Price index	New input coefficient for primary inputs	Price index
		1	2	3	4	5	6	7	8	9	10
		Inverse $(I-A)^{-1}$						v	p	v	p
1	Agriculture	1.0339	0.2896	0.0207	0.1269	0.1842	0.0495	0.5847	1.0000	0.5847	1.0150
2	Manufacturing	0.0350	1.4292	0.0191	0.1214	0.2071	0.0295	0.5171	1.0000	0.5689	1.0739
3	Construction	0.0100	0.3961	1.0289	0.1064	0.2503	0.0218	0.5317	1.0000	0.5317	1.0205
4	Trade	0.0051	0.1420	0.0211	1.1784	0.2239	0.0331	0.6327	1.0000	0.6327	1.0073
5	Business services	0.0030	0.0596	0.0500	0.0356	1.4126	0.0342	0.6314	1.0000	0.6314	1.0031
6	Other services	0.0044	0.1073	0.0250	0.0631	0.1269	1.0515	0.7690	1.0000	0.7690	1.0056

The consumer price index is commonly used to measure inflation. After the price increase in manufacturing, the new set of price indexes is used to inflate private consumption product by product (Table 15.24). If, in a given year, costs for primary inputs in manufacturing are expected to increase by 10 percent, then the consumer price index will be expected to grow by 2.2 percent.

Table 15.24: The impact of price increases in manufacturing on the consumer price index

		Old private consumption	New private consumption	Growth rate in %
		1	2	3
1		8 500	8 627	1.5
2	Manufacturing	197 792	212 410	7.4
3	Construction	3 457	3 528	2.0
4	Trade	269 663	271 643	0.7
5	Business services	214 757	215 419	0.3
6	Other services	119 504	120 167	0.6
7	Total	813 673	831 795	2.2

In an open and integrated economy the impact of import prices on inflation can not be neglected. In our model economy the import content of final demand for domestic products is 11.5 percent. If we assume that import prices rise by 10 percent per annum then the consumer price index is expected to increase by 1.0 percent.

Energy taxes increase the general price level

In some countries the mineral oil tax on gasoline and diesel was recently increased to induce sustainable growth and protect the environment. According to our calculation it must be expected that the consumer price index will increase by 1.4 percent if the tax on fuel is doubled.

Salaries and wages determine the general price level

Despite the substantial increases in labour productivity, salaries and wages constitute the most substantial cost component in most industries. Rising wages, allowances and other contributions for employees seem to threaten the competitiveness of many economies. If wages were increased by 10.0 percent, the inflation rate is expected to increase by 5.0 percent according to the input-output calculation. However, the expected price increase is quite different in the various sectors of the economy. The following changes are expected for product prices:

- Agriculture 4.2 %
- Manufacturing 5.1 %
- Construction 5.4 %
- Trade 5.7 %
- Business services 3.2 %
- Other services 6.5 %
- Economy 5.0 %

The replacement of capital goods in time

In developed countries, in particular, capital consumption content constitutes a significant cost component of final demand. In most cases private companies finance the replacement of capital goods with allowances for depreciation. The input-output approach allows assessing the direct and indirect replacement requirements for final demand.

15.2 Other applications

15.2.1 Input-output models with endogenous final demand

In the usual form of the standard demand-side input-output model, the final demand elements are considered exogenous. However, private consumption and investment in many respects depend on income. The basic idea of introducing more endogenous variables is to separate the components of final demand into autonomous and variable elements. For private consumption the Keynesian consumption function $C = a + bY$ and investment function $I = h + dY$ may be introduced, in which the absolute terms reflect the autonomous parts of private consumption (a) and investment (h) while the marginal propensities to consume (b) and invest (d) represent the variable parts of consumption and investment which are induced by the level of income. For the remaining components of final demand (government consumption, exports) it does not seem to be feasible to treat them in a corresponding way as endogenous variables.

In the previous analysis, private consumption and consequently private household activities are exogenous. A more refined income multiplier analysis for wages tries to include the household sector as an endogenous activity. The income earned by private households is spent to a large extent for private consumption. This induces higher incomes, which again induces more private consumption.

The following partitioned matrix D in Table 15.25 includes the matrix A with input coefficients for intermediates, the row vector B with input coefficients for wage requirements and the column vector C with input coefficients for private consumption. In this example the input coefficients for private consumption are related to the total for compensation of employees.

A = matrix of input coefficients for intermediate consumption of products
B = row vector of input coefficients for wages
C = column vector of input coefficients for private consumption related to compensation of employees
E = element with zero (no entry)
D = partitioned matrix of input coefficients

Table 15.25: Input-output model with endogenous final demand

		Agriculture	Industry	Services	Private consumption
		1	2	3	4
1	Agriculture				
2	Industry		A		C
3	Services				
4	Wages		B		E

The inverse in equation (68) reflects the direct and indirect requirements for products and wages. The last row of the inverse can be interpreted as the corresponding income multipliers for wages in an input-output system with endogenous private household sector.

(68) $H = (I - D)^{-1}$ Direct and indirect requirements for products and wages

I = unit matrix
D = partitioned matrix with input coefficients for intermediates, wages and private consumption
H = matrix with results for direct and indirect requirements for products and wages

The wage multiplier with exogenous private consumption for agriculture was $h_1 = 0.4172$ (see row 6 in Table 15.16). If private consumption and wages and salaries are treated as endogenous variables, the wage multiplier rises to $h_1 = 0.7048$ in the last row of Table 15.26.

Table 15.26: Income multiplier for wages with endogenous private consumption

No.		Agriculture	Manufacturing	Construction	Trade	Business services	Other services	Private consumption
		1	2	3	4	5	6	7
					INPUT COEFFICIENTS			
1	Agriculture	0.0258	0.0236	0.0000	0.0011	0.0010	0.0015	0.0085
2	Manufacturing	0.1806	0.2822	0.2613	0.0761	0.0173	0.0597	0.1984
3	Construction	0.0097	0.0068	0.0158	0.0098	0.0339	0.0180	0.0035
4	Trade	0.0811	0.0674	0.0578	0.1378	0.0156	0.0413	0.2705
5	Business services	0.0828	0.0890	0.1263	0.1218	0.2790	0.0672	0.2154
6	Other services	0.0353	0.0139	0.0071	0.0208	0.0217	0.0434	0.1199
7	Compensation of employees	0.2137	0.2746	0.3209	0.3971	0.1802	0.5364	0.0000
					LEONTIEF MATRIX			
1	Agriculture	0.9742	-0.0236	0.0000	-0.0011	-0.0010	-0.0015	-0.0085
2	Manufacturing	-0.1806	0.7178	-0.2613	-0.0761	-0.0173	-0.0597	-0.1984
3	Construction	-0.0097	-0.0068	0.9842	-0.0098	-0.0339	-0.0180	-0.0035
4	Trade	-0.0811	-0.0674	-0.0578	0.8622	-0.0156	-0.0413	-0.2705
5	Business services	-0.0828	-0.0890	-0.1263	-0.1218	0.7210	-0.0672	-0.2154
6	Other services	-0.0353	-0.0139	-0.0071	-0.0208	-0.0217	0.9566	-0.1199
7	Compensation of employees	-0.2137	-0.2746	-0.3209	-0.3971	-0.1802	-0.5364	1.0000
					INVERSE			
1	Agriculture	1.0468	0.0508	0.0268	0.0229	0.0130	0.0246	0.0310
2	Manufacturing	0.5374	1.7305	0.7169	0.4821	0.2497	0.4935	0.5938
3	Construction	0.0397	0.0422	1.0536	0.0472	0.0646	0.0547	0.0456
4	Trade	0.3803	0.4296	0.4345	1.5263	0.2300	0.4581	0.6073
5	Business services	0.4828	0.5702	0.6369	0.6338	1.6417	0.5923	0.7156
6	Other services	0.1543	0.1570	0.1575	0.1770	0.1147	1.2149	0.2512
7	Compensation of employees	0.7048	0.8573	0.9125	0.9677	0.5408	1.0987	1.6892

Table 15.27 demonstrates that the given output levels of Table 15.3 can be restored with the quantity model of input-output analysis.

Table 15.27: Quantity model with endogenous private consumption

No.		Agriculture	Manufac-turing	Construc-tion	Trade	Business services	Other services	Private consump-tion	Final demand	Output
		1	2	3	4	5	6	7	8	7
					INVERSE $(I-A)^{-1}$				y	x
1	Agriculture	1.0468	0.0508	0.0268	0.0229	0.0130	0.0246	0.0310	6 719	43 910
2	Manufacturing	0.5374	1.7305	0.7169	0.4821	0.2497	0.4935	0.5938	421 550	1 079 446
3	Construction	0.0397	0.0422	1.0536	0.0472	0.0646	0.0547	0.0456	192 606	245 606
4	Trade	0.3803	0.4296	0.4345	1.5263	0.2300	0.4581	0.6073	73 692	540 063
5	Business services	0.4828	0.5702	0.6369	0.6338	1.6417	0.5923	0.7156	53 797	692 487
6	Other services	0.1543	0.1570	0.1575	0.1770	0.1147	1.2149	0.2512	322 776	508 918
7	Compensation of employees	0.7048	0.8573	0.9125	0.9677	0.5408	1.0987	1.6892	0	996 900

15.2.2 Linear programming models

With his first publications from 1936 to 1941 Leontief (Leontief 1936, Leontief 1937, Leontief 1941) founded the input-output analysis. Dantzig (Dantzig 1951) developed in 1951 the simplex algorithm to solve linear optimisation problems. His simplex algorithm is still the basic foundation of linear programming and operations research. Dorfman, Samuelson and Solow (Dorfman, Samuelson and Solow 1958) discussed in 1958 the close relationship between input-output analysis and linear programming. Although many books and articles on this subject have been published since then, only a few empirical applications of operations research instruments in input-output models have been implemented so far. In this context the publications of Koopmans (Koopmans 1951), Chipman (Chipman 1953), Dorfman (Dorfman 1953), Chenery and Clark (Chenery and Clark 1959), Schumann (Schumann 1968), Gosh (Gosh 1968), Bomsdorf (Bomsdorf 1977), Pasinetti (Pasnetti 1977) and Beutel (Beutel 1982a) are of interest.

Mathematically, input-output analysis can be regarded as a special case of linear programming models. Both approaches are methodologies to solve linear equation systems. This chapter will show that the traditional price and quantity models of input-output analysis can be transformed into linear programming models with a substantial gain of information for the users, in particular on constraints and shadow prices. The main advantage of a linear programming model is the fact that the model includes all information from the four quadrants of the input-output table. It comprises the entire production system including all primary inputs. In contrast, the traditional quantity and prices models encompass only two quadrants of an input-output table at a time.

One of the important features of linear optimisation is the fact that to each linear programming problem a corresponding dual problem exists. If the original problem, called the primal problem, is a maximum problem then the dual problem is a minimum problem. The general input-output model in the linear programming version simultaneously comprises the primal quantity model and the dual price model. A second major advantage is the fact that linear input-output programming models are not restricted to square matrices (Matuszewski 1972) but can deal with rectangular input-output systems. In other words, in an input-output model the number of products does not have to equal the number of activities.

For linear models, the traditional approach of input-output analysis is best expressed by an application of linear programming. We begin with a simple numerical example. For a closed economy the following input-output table in Table 15.28 is given in value terms.

The initial version of the traditional input-output models (quantity model) is used to project commodity outputs for an exogenously given vector of final demand. The dual version (price model) is often implemented to analyse changes in commodity prices which are induced by changes of costs for primary inputs (wages, consumption of fixed capital, production taxes, subsidies, profits). Both models can be formulated in physical units and in value units (Polenske 1977).

The basic quantity model of input-output analysis consists of two of the four quadrants of an input-output table, namely the first quadrant for the intermediate input requirements and the second quadrant for the components of final demand. With the next conventional step, we will determine for our example the activity levels of production for an exogenously given vector of final demand.

Table 15.28: Input-output table

		Agriculture	Coal	Electricity	Industry	Services	Final demand	Output
		1	2	3	4	5	6	7
1	Agriculture	10	60	5	9	12	4	100
2	Coal	20	30	40	30	30	50	200
3	Electricity	10	20	20	90	60	200	400
4	Industry	30	12	24	120	90	324	600
5	Services	6	24	12	21	15	222	300
6	Labour	24	54	299	330	93	0	800
7	Input	100	200	400	600	300	800	2400

Primal model in physical units

(69) $Q = FQ + Z$
(70) $Q - FQ = Z$
(71) $(I - F)Q = Z$
(72) $Q = (I - F)^{-1} Z$

Primal model in value units

$Y = AX + Y$
$X – AX = Y$
$(I-A)X = Y$
$X = (I - A)^{-1} Y$

Dual model in physical units

(73) $P = F'P + W$
(74) $P – F'P = W$
(75) $(I - F')P = W$
(76) $P = (I - F')^{-1} W$

Dual model in value units

$V = A'V+ U$
$V – A'V = U$
$(I - A')V = U$
$V = (I - A')^{-1} U$

F = matrix of technical input coefficients for commodities in physical units
Q = vector of commodity output in physical units
Z = vector of final demand in physical units

A = matrix of technical input coefficients for commodities in value units
X = vector of commodity output in value units
Y = vector of final demand in value units

F' = transposed matrix of technical input coefficients for commodities in physical units
P = vector of commodity price indexes
W = vector of value added per unit of output in physical units

A' = transposed matrix of technical input coefficients for commodities in value units
V = vector of relative prices
U = vector of value added per unit of output in value units

The primal model and the solution is presented in Table 15.29.

Table 15.29: Primal model and solution

Primal model in value units Ax + y = x

		Ax				x		y		x
0.1000	0.3000	0.0125	0.0150	0.0400		x_1		4		x_1
0.2000	0.1500	0.1000	0.0500	0.1000		x_2		50		x_2
0.1000	0.1000	0.0500	0.1500	0.2000	*	x_3	+	200	=	x_3
0.3000	0.0600	0.0600	0.2000	0.3000		x_4		324		x_4
0.0600	0.1200	0.0300	0.0350	0.0500		x_5		222		x_5

Solution of the linear equation system $x = (I - A)^{-1} y$

		$(I - A)^{-1}$				y		x
1.2603	0.4792	0.0762	0.0741	0.1430		4		100
0.3847	1.3749	0.1658	0.1347	0.2384		50		200
0.2988	0.3049	1.1157	0.2495	0.3584	*	200	=	400
0.5836	0.3912	0.1496	1.3362	0.5192		324		600
0.1591	0.2280	0.0665	0.0788	1.1222		222		300

In contrast to this approach, the general input-output model of activity analysis contains all four quadrants of an input-output tables covering intermediate inputs, final demand and primary inputs (value added). The first challenge is to formulate a linear programming model which reproduces the same solution of the preceding primal model of input-output analysis.

The Leontief system A will be:

Maximise

(77) $Z = PX$ Objective function

subject to

(78) $X - AX = Y$ Constraints for products
(79) $-BX = 0$ Constraints for primary inputs (labour)
(80) $X \geq 0$ Non-negativity

A = matrix of technical input coefficients for commodities
B = matrix of technical input coefficients for primary inputs (labour)
X = vector of commodity output and employment of primary inputs
Y = vector of final demand
P = vector of prices

The linear programming model in the Leontief System A reproduces the inverse of the traditional input-output model. For this system the objective is to maximise revenue subject to the constraints of an exogenously given vector of final demand and a given technology for intermediate production. Assuming that all inputs are in the possession of the economy, the objective to maximise profits implies the objective to maximise revenues. In reference to the price model, the fictitious prices of all commodities in the objective function will be set at $p_j = 1.0$, provided that all input coefficients for intermediate and primary inputs add up column-wise to unity. In consequence, the vector P in the objective function is a vector of unity prices for the different commodities. The traditional quantity model of input-output analysis with exogenous final demand implies that labour is not constrained in the market.

At first sight it is obvious that the competing data of the linear programming model corresponds to the inverse matrix (lines 1-5 of the solution). The results in line 6 are equivalent with the unit prices indices of the dual price model. The results in the last row correspond to the column totals of the inverse indicating the economic multipliers for backward linkages.

Table 15.30: Leontief System A

		ACTIVITIES						SLACK VARIABLES						Restriction
		Agriculture	Coal	Electricity	Industry		Services	Agriculture	Coal	Electricity	Industry	Services	Labour	
		x_1	x_2	x_3	x_4		x_5	y_1	y_2	y_3	y_4	y_5	y_6	Q
STATEMENT														
Agriculture	y_1	0.9000	-0.3000	-0.0125	-0.0150		-0.0400	1.0000						4.0
Coal	y_2	-0.2000	0.8500	-0.1000	-0.0500		-0.1000		1.0000					50.0
Electricity	y_3	-0.1000	-0.1000	0.9500	-0.1500		-0.2000			1.0000				200.0
Industry	y_4	-0.3000	-0.0600	-0.0600	0.8000		-0.3000				1.0000			324.0
Services	y_5	-0.0600	-0.1200	-0.0300	-0.0350		0.9500					1.0000		222.0
Labour	y_6	-0.2400	-0.2700	-0.7475	-0.5500		-0.3100						1.0000	0.0
Objective	Z	-1.0000	-1.0000	-1.0000	-1.0000		-1.0000							0.0
SOLUTION														
Agriculture	x_1	1.0000						1.2603	0.4792	0.0762	0.0741	0.1430		100.0
Coal	x_2		1.0000					0.3847	1.3749	0.1658	0.1347	0.2384		200.0
Electricity	x_3			1.0000				0.2988	0.3049	1.1157	0.2495	0.3584		400.0
Industry	x_4				1.0000			0.5836	0.3912	0.1496	1.3362	0.5192		600.0
Services	x_5						1.0000	0.1591	0.2280	0.0665	0.0788	1.1222		300.0
Labour	y_6							1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	800.0
Objective	Z							2.6885	2.7782	1.5739	1.8733	2.3811		1600.0

In the next step an important result of modern consumer theory is introduced which promotes the idea that consumers are more interested in carrying out certain consumption activities than in consuming single commodities. In the following Leontief system B we consider only one aggregate final demand activity. The capacity of labour is restricted to the given level of Table 15.12 (L° = 800).

The valuation of the final demand vector in the objective function (P_6 = 1.0) can be regarded as the 'numéraire' of the economic system.

The Leontief system B has the following structure:

Maximise

(81) Z = PX   Objective function

subject to

(82) AX – X = 0   Constraints for products
(83) BX = L°   Constraints for primary inputs (labour)
(84) X ≥ 0   Non-negativity

A = matrix of technical input coefficients for commodities
B = matrix of technical input coefficients for primary inputs (labour)
X = vector of commodity output and employment of primary inputs
P = vector of prices
L° = capacity constraint for labour

Again, the inverse production coefficients of input-output analysis can be derived from the competing linear programming data (Beutel and Mürdter 1982). In the linear programming model each cumulative (inverse) coefficient can be split into two components which represent the capacity effect of primary resources and the structural effect of final demand. The first set of competing data in columns 7-11 of Table 15.31 include the results of a marginal change of the given structure of final demand under the constraint that the capacity of primary resources remains unchanged. In this situation some production activities can expect gains, while others must expect losses in output. The effect is shown in column 12, which results from a marginal change of the capacity of primary resources if the structure of final demand remains unchanged. In this situation all activities can expect higher output levels. The difference of both structural components will lead to the well-known inverse of the system. The elements of the inverse can be computed in the following way: Competing data for labour less competing data for commodities equals the corresponding element of the inverse. The first two elements of the inverse are calculated as

0.1250-(-1.1353) = 1.2603 and 0.1250 - (-0.3542) = 0.4792.

Table 15.31: Leontief system B

		ACTIVITIES						SLACK VARIABLES						Restriction
		Agriculture	Coal	Electricity	Industry	Services	Final demand	Agriculture	Coal	Electricity	Industry	Services	Labour	
		x_1	x_2	x_3	x_4	x_5	x_6	y_1	y_2	y_3	y_4	y_5	y_6	Q
STATEMENT														
Agriculture	y_1	-0.9000	0.3000	0.0125	0.0150	0.0400	0.0050	1.0000						0.0
Coal	y_2	0.2000	-0.8500	0.1000	0.0500	0.1000	0.0625		1.0000					0.0
Electricity	y_3	0.1000	0.1000	-0.9500	0.1500	0.2000	0.2500			1.0000				0.0
Industry	y_4	0.3000	0.0600	0.0600	-0.8000	0.3000	0.4050				1.0000			0.0
Services	y_5	0.0600	0.1200	0.0300	0.0350	-0.9500	0.2775					1.0000		0.0
Labour	y_6	0.2400	0.2700	0.7475	0.5500	0.3100	0.0000						1.0000	800.0
Objective	Z						-1.0000							0.0

SOLUTION

Agriculture	x_1						1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	800.0
Coal	x_2	1.0000						-1.1353	-0.3542	0.0488	0.0509	-0.0180	0.1250	100.0
Electricity	x_3		1.0000					-0.1347	-1.1249	0.0842	0.1153	0.0116	0.2500	200.0
Industry	x_4			1.0000				0.2012	0.1951	-0.6157	0.2505	0.1416	0.5000	400.0
Services	x_5				1.0000			0.1664	0.3588	0.6004	-0.5862	0.2308	0.7500	600.0
Labour	y_6					1.0000		0.2159	0.1470	0.3085	0.2962	-0.7472	0.3750	300.0
Objective	Z							1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	800.0

The main characteristics of the general input-output model can be summarised in the following way:

- **Primal and dual model**
  An essential advantage of the linear programming model is the fact that it comprises the entire production system. It evaluates all information of an input-output table in a simultaneous way. The primal quantity model and the dual price model are included in the optimal solution at the same time.

- **Shadow prices and cumulative input coefficients**
  The cumulative (inverse) production coefficients can be derived from the competing data of the linear programming model. In addition, the solution includes shadow prices for the different commodities and indicators for the intensity of backward linkages.

- **Rectangular input-output systems**
  Rectangular input-output systems can be solved with linear programming input-output models. No valuable statistical information is lost by the aggregation to square matrices.

- **Substitution**
  The traditional input-output model is based on Leontief production functions with no substitution of inputs. In a linear programming model the substitution of techniques can be examined.

According to the theorem of non-substitution, only one production activity out of many techniques is efficient to produce a certain commodity independent of the structural composition of final demand if only one primary input and no joint production exists. In a situation with more than one primary input the structure of final demand has a distinct influence on the choice of techniques (Samuelson 1951, Chipman 1953).

15.2.3 Dynamic input-output models

Intermediates reflect the flows of goods between sectors which were purchased for current production needs during a particular period of time. However, some inputs contribute to the production process but are not immediately used up during production. In other words, a sector has a certain capital stock of machinery, buildings and transport equipment that is also necessary for production. In consequence, investments are required for replacements and capacity additions.

The dynamic input-output models are designed in line with the multiplier-accelerator analysis of macroeconomic theory. According to this theory it is expected that investment is induced if final demand is expected to grow.

Expected growth

If we assume that induced investment is a function of expected growth, the typical equations of the dynamic input-output model would become:

(85) $X_t = AX_t + C_t + D_t$
(86) $D_t = BX_{t+1} - BX_t$
(87) $X_t = AX_t + C_t + BX_{t+1} - BX_t$
(88) $(I - A + B)X_t = C_t + BX_{t+1}$

The production of period t is defined:

(89) $X_t = (I - A + B)^{-1} (C_t + BX_{t+1})$

while the production of period t+1 is determined by:

(90) $X_{t+1} = B^{-1}[(I - A + B)X_t - C_t]$

X = output
Y = final demand
I = unit matrix
A = input coefficients for intermediates
$(I-A)^{-1}$ = matrix of cumulative input coefficients (inverse)
B = input coefficients for capital
C = exogenous final demand (consumption)
D = induced investment
T = time index

This is a system of linear difference equations, since the values of the variables are related to different periods of time. Consumption is expected to grow at the annual rate $(1+m)^t$. Practical problems relate to the matrix B of capital coefficients.

Box 15.4: Linear programming

A simple production problem

A common linear programming problems contains three elements: the linear objective function, the linear constraints and the non-negativity condition for the variables. The model may be specified as a maximisation or the dual minimisation problem. In the following example the profit shall be maximised for a 2-product-company, which owns 3 machines. All product and factor prices are given and the production coefficients and capacities of the machines are known.

Maximise		Maximise
(1) $G = z_1x_1 + z_2x_2$	Objective function	(6) $G = 13x_1 + 17x_2$
subject to		suject to
(2) $a_{11}x_1 + a_{12}x_2 \leq v_1°$	Restrictions (constraints)	(7) $18x_1 + 12x_2 \leq 216$
(3) $a_{21}x_1 + a_{22}x_2 \leq v_2°$		(8) $14x_1 + 14x_2 \leq 196$
(4) $a_{31}x_1 + a_{32}x_2 \leq v3°$		(9) $12x_1 + 24x_2 \leq 288$
and		and
(5) $x_1 \geq 0, x_2 \geq 0$	Non-negativity	(10) $x_1 \geq 0, x_2 \geq 0$

a_ij = machine hours per unit of output
z_j = profit per unit of output
x_j = output

yi = slack variables
vi° = capacity of machines
Z = Profit

SIMPLEX ALGORITHM

Tableau 1 : Statement

		Product 1	Product 2	Slack variables			Capacity
		x_1	x_2	y_1	y_2	y_3	Q
Machine A	y_1	18	12	1	0	0	216
Machine B	y_2	14	14	0	1	0	196
Machine C	y_3	12	24	0	0	1	288
Objective	Z	-13	-17	0	0	0	0

Tableau 2 : Interim results

		Product 1	Product 2	Slack variables			Capacity
		x_1	x_2	y_1	y_2	y_3	Q
Machine A	y_1	12.0000	0	1	0	-0.5000	72
Machine B	y_2	7.0000	0	0	1	-0.5833	28
Product 2	y_3	0.5000	1	0	0	0.0417	12
Objective	Z	-4.5000	0	0	0	0.7083	204

Tableau 3 : Solution

		Product 1	Product 2	Slack variables			Capacity
		x_1	x_2	y_1	y_2	y_3	Q
Machine A	y_1	0	0	1	-1.7143	0.5000	24
Product 1	y_2	1	0	0	0.1429	-0.0833	4
Product 2	y_3	0	1	0	-0.0714	0.0833	10
Objective	Z	0	0	0	0.6429	0.3333	222

= pivot row and pivot column

Solution

$x_1 = 4$	Output of product 1	$y_1 = 24$	Unused capacity of machine A
$x_2 = 10$	Output of product 1	$s_1 = 0.6429$	Shadow price of machine B
$Z = 222$	Operating surplus	$s_2 = 0.3333$	Shadow price of machine C

Only a few of the branches produce capital goods. Therefore it can not be expected that matrix B has an inverse. There is a large literature on the singularity problem in the dynamic input-output model and many problems remain for empirical applications.

In the previous approach it is assumed that capital goods (buildings, machinery) have an eternal service life. Capital goods however have a finite time of use. Consumption of fixed capital and retirements must reflect the actual service lives of capital goods in operation, while net investment will increase, if the various capacities of the industries have to be extended (Beutel 1997). The integration of capital stock data and employment data into input-output models will provide a consistent system of stocks and flows (Johansen 1978).

In assessing investment, we wish to distinguish between replacement of old capital goods by new capital goods and new equipment for the expansion of the production capacity. Replacements are a function of current production depending on the actual lifetime of capital goods and additions to the capital stock are a function of economic growth. In this case we may rewrite the equation (87) as

(91) $X_t = AX_t + RX_t + C_t + EX_{t+1} - EX_t$

R = matrix input coefficients for replacement of capital goods
E = matrix of input coefficients for the expansion of the capital stock

A three-period example

We consider equation (88) and write it as

(92) $(I - A + B)X_t - BX_{t+1} = C_t$

If we denote (I – A + B) by G and let t = 3, then the difference equation relationships are

$$(93)\quad \begin{aligned} GX^{\circ} - BX^1 &= Y^{\circ}\\ GX^1 - BX^2 &= Y^1\\ GX^2 - BX^3 &= Y^2\\ GX^3 - BX^4 &= Y^3 \end{aligned} \quad \text{or} \quad \begin{bmatrix} G & -B & 0 & 0 & 0\\ 0 & G & -B & 0 & 0\\ 0 & 0 & G & -B & 0\\ 0 & 0 & 0 & G & -B \end{bmatrix} * \begin{bmatrix} X^{\circ}\\ X^1\\ X^2\\ X^3\\ X^4 \end{bmatrix} = \begin{bmatrix} Y^{\circ}\\ Y^1\\ Y^2\\ Y^3 \end{bmatrix}$$

There are four matrix equations involving five unknown vectors x° through x^4. The issue in the dynamic input-output model is which values will be specified as fixed in the dynamic process. There are initial values at t = 0 with output levels of the economy and terminal values reflecting desired characteristics of the input-output system at the end of the analysed period, for example for t = 3.

Terminal conditions

If we assume that t = 3 and the last year is not of interest ($x^4 = 0$), then we may write equation (67) for the terminal conditions as

$$(94)\quad \begin{aligned} GX^{\circ} - BX^1 &= Y^{\circ}\\ GX^1 - BX^2 &= Y^1\\ GX^2 - BX^3 &= Y^2\\ GX^3 \qquad &= Y^3 \end{aligned} \quad \text{or} \quad \begin{bmatrix} G & -B & 0 & 0\\ 0 & G & -B & 0\\ 0 & 0 & G & -B\\ 0 & 0 & 0 & G \end{bmatrix} * \begin{bmatrix} X^{\circ}\\ X^1\\ X^2\\ X^3 \end{bmatrix} = \begin{bmatrix} Y^{\circ}\\ Y^1\\ Y^2\\ Y^3 \end{bmatrix}$$

If a projection of the final demand vector exists, we can derive the associated output levels provided that the inverse of the matrix with G and B exists.

$$(95)\quad \begin{bmatrix} G & -B & 0 & 0\\ 0 & G & -B & 0\\ 0 & 0 & G & -B\\ 0 & 0 & 0 & G \end{bmatrix}^{-1} * \begin{bmatrix} Y^{\circ}\\ Y^1\\ Y^2\\ Y^3 \end{bmatrix} = \begin{bmatrix} X^{\circ}\\ X^1\\ X^2\\ X^3 \end{bmatrix}$$

Box 15.5: Dynamic input-output model

In dynamic input-output models investment is treated as an endogenous variable in line with the acceletaror analysis of macroeconomic theory. Investment is induced if final demand is expected to grow. The main assumptions of the following dynamic input-output models are:

1. The input coefficients for goods and services and primary inputs are given.
2. The capital coefficients are known.
3. The capital good have an eternal lifetime of use.
4. All branches are producing at full capacities.
5. Investment is a function of expected growth.

(1) $X_t = AX_t + C_t + I_t$
(2) $I_t = BX_{t+1} - BX_t$
(3) $C_t = (1 + m)_t\, C(0)$
(4) $X_t = AX_t + C_t + BX_{t+1} - BX_t$

Production in period t+1 is determined by:

(5) $X_{t+1} = B - 1[(I - A + B)X_t - C_t]$

X = output
Y = final demand
I = unit matrix
A = input coefficients for intermediates
$(I-A)^{-1}$ = inverse
B = input coefficients for capital
C = exogenous final demand
I = induced investment
m = growth factor for consumption
t = time index

Input-output table t = 0

	A	B	C	I	X
	Input-output table				
A	7.00	39.00	10.00	14.00	70.00
B	35.00	13.00	8.00	9.00	65.00
V	28.00	13.00	0.00	0.00	41.00
X	70.00	65.00	18.00	23.00	176.00
	Capital				
M	0.00	130.00	0.00	0.00	130.00
T	280.00	0.00	0.00	0.00	280.00
Total	280.00	130.00	0.00	0.00	410.00

A = Agriculture
B = Industry
V = Value added
C = Consumption
I = Investment
X = Output
M = Machinery
T = Transport equipment

Input coefficients A

A	0.1000	0.6000
B	0.5000	0.2000

Capital coefficients B

M	0.0000	2.0000
T	4.0000	2.0000

Inverse capital coefficients B^{-1}

M	-0.2500	0.2500
T	0.5000	0.0000

Leontief matrix I-A

A	0.9000	-0.6000
B	-0.5000	0.8000

G = I-A+B

A	0.9000	1.4000
B	3.5000	2.8000

$$(6)\quad \begin{bmatrix} -B & 0 & 0 \\ G & -B & 0 \\ 0 & G & -B \end{bmatrix} * \begin{bmatrix} X(1) \\ X(2) \\ X(3) \end{bmatrix} = \begin{bmatrix} Y(0)-GX(0) \\ Y(1) \\ Y(2) \end{bmatrix}$$

$$(7)\quad \begin{bmatrix} -B & 0 & 0 \\ G & -B & 0 \\ 0 & G & -B \end{bmatrix}^{-1} * \begin{bmatrix} Y(0)-GX(0) \\ Y(1) \\ Y(2) \end{bmatrix} = \begin{bmatrix} X(1) \\ X(2) \\ X(3) \end{bmatrix}$$

$$(8)\quad \begin{bmatrix} 0.0000 & -2.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ -4.0000 & -2.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ 0.9000 & 1.4000 & 0.0000 & -2.0000 & 0.0000 & 0.0000 \\ 3.5000 & 2.8000 & -4.0000 & 0.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.9000 & 1.4000 & 0.0000 & -2.0000 \\ 0.0000 & 0.0000 & 3.5000 & 0.8000 & -4.0000 & 0.0000 \end{bmatrix} * \begin{bmatrix} X_1 \\ X_2 \\ X_1 \\ X_2 \\ X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} -144.00 \\ -289.00 \\ 10.50 \\ 8.40 \\ 11.03 \\ 8.82 \end{bmatrix}$$

$$(9)\quad \begin{bmatrix} 0.2500 & -0.2500 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ -0.5000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ -0.1313 & -0.2188 & 0.0000 & -0.2500 & 0.0000 & 0.0000 \\ -0.2375 & -0.1125 & -0.5000 & 0.0000 & 0.0000 & 0.0000 \\ -0.1623 & -0.2139 & -0.1000 & -0.2188 & 0.0000 & -0.2500 \\ -0.2253 & -0.1772 & -0.3500 & -0.1125 & -0.5000 & 0.0000 \end{bmatrix} * \begin{bmatrix} -144.00 \\ -289.00 \\ 10.50 \\ 8.40 \\ 11.03 \\ 8.82 \end{bmatrix} = \begin{bmatrix} 36.25 \\ 72.00 \\ 80.02 \\ 61.46 \\ 80.10 \\ 73.52 \end{bmatrix}$$

Final demand and capital requirements in the base year t = 0

G		X(0)	GX(0)
0.9	1.4	70	154
3.5	0.8	65	297

Final demand demand vector with consumption growing at 5 percent per year (m = 0.05)

C(0)	$(1+m)^t$	C(t)	GX(0)	Y
10.00	1.0000	10.00	154.00	-144.00
8.00	1.0000	8.00	297.00	-289.00
10.00	1.0500	10.50	0.00	10.50
8.00	1.0500	8.40	0.00	8.40
10.00	1.1025	11.03	0.00	11.03
8.00	1.1025	8.82	0.00	8.82

$C(t) = (1+m)^t\, C(0)$

Input-output table t = 1

	A	B	C	I	X
	Input-output table				
A	7.23	43.20	10.50	11.33	72.25
B	36.13	14.40	8.40	13.08	72.00
V	28.90	14.40	0.00	0.00	43.30
X	72.25	72.00	18.90	24.40	187.55
	Capital				
M	0.00	144.00	0.00	0.00	144.00
T	289.00	0.00	0.00	0.00	289.00
Total	289.00	144.00	0.00	0.00	433.00

Input-output table t = 2

	A	B	C	I	X
	Input-output table				
A	7.55	46.60	10.50	10.87	75.52
B	37.76	15.53	8.40	15.97	77.66
V	30.21	15.53	0.00	0.00	45.74
X	75.52	77.66	18.90	26.84	198.92
	Capital				
M	0.00	155.33	0.00	0.00	155.33
T	302.08	0.00	0.00	0.00	302.08
Total	302.08	155.33	0.00	0.00	457.40

Input-output table t = 3

	A	B	C	I	X
	Input-output table				
A	7.94	49.70	11.03	10.74	79.41
B	39.70	16.57	8.82	17.74	82.83
V	31.76	16.57	0.00	0.00	48.33
X	79.41	82.83	19.85	28.48	210.57
	Capital				
M	0.00	165.67	0.00	0.00	165.67
T	317.63	0.00	0.00	0.00	317.63
Total	317.63	165.67	0.00	0.00	483.30

Initial conditions

In general systems of difference equations, it is often assumed that the initial (t = 0) values of all elements in the system are known, for instance in form of an input-output table for the base year. In this case, the usefulness of the model comes from the description of the variables in subsequent years. The system of equations found sequentially can be written as

$$(96)\quad \begin{array}{l} -BX^1 = Y^\circ - GX^\circ \\ GX^1 - BX^2 = Y^1 \\ GX^2 - BX^3 = Y^2 \\ GX^3 - BX^4 = Y^3 \end{array} \quad \text{or} \quad \begin{bmatrix} -B & 0 & 0 & 0 \\ G & -B & 0 & 0 \\ 0 & G & -B & 0 \\ 0 & 0 & G & -B \end{bmatrix} * \begin{bmatrix} X^1 \\ X^2 \\ X^3 \\ X^4 \end{bmatrix} = \begin{bmatrix} Y^\circ\text{-}GX^\circ \\ Y^1 \\ Y^2 \\ Y^3 \end{bmatrix}$$

The solution of this system depends on the non-singularity of the coefficient matrix, in particular on the non-singularity of the B matrix on the main diagonal. In fact, singularity of the B matrix creates problems in many dynamic input-output models. One main reason is the fact that in large input-output tables only very few sectors provide capital goods and in consequence many rows of the B matrix are empty.

$$(97)\quad \begin{bmatrix} -B & 0 & 0 & 0 \\ G & -B & 0 & 0 \\ 0 & G & -B & 0 \\ 0 & 0 & G & -B \end{bmatrix}^{-1} * \begin{bmatrix} Y^\circ\text{-}GX^\circ \\ Y1 \\ Y2 \\ Y3 \end{bmatrix} = \begin{bmatrix} X^1 \\ X^2 \\ X^3 \\ X^4 \end{bmatrix}$$

Actual growth

If we assume that investment in period t+1 is a function of actual growth, the dynamic input-output model is defined as:

(98) $X_{t+1} = AX_{t+1} + C_{t+1} + I_{t+1}$
(99) $I_{t+1} = BX_{t+1} - BX_t$
(100) $X_{t+1} = AX_{t+1} + C_{t+1} + BX_{t+1} - BX_t$
(101) $(I - A - B)X_{t+1} = C_{t+1} - BX_t$

The production of period t+1 and period t are defined as

(102) $X_{t+1} = (I - A - B)^{-1} (C_{t+1} - BX_t)$
(103) $X_t = B^{-1}[(A - I + B)X_{t+1} + C_{t+1}]$

If all branches are producing at full capacity, the accelerator mechanism can result in unstable fluctuations depending on the parameters estimated. Therefore, it is recommended to relate induced investment to the stable components of final demand, namely consumption and exports. A substantial part of investment is required for replacement of capital goods. Additional capacity is required if the final demand components are growing. On the other hand, capacity must be reduced if final demand decreases. Dynamic input-output models try to reflect these decisions.

In the following example it is assumed that investment in period t is a function of actual growth between the period t = 0 and period t = 1 and investment is induced as indicated in equation (87).

Table 15.32: Input-output table of base year t = 0

	Millions of Euro						Input coefficients			
	Industry	Construc-tion	Consump-tion	Invest-ment	Final demand	Output	Industry	Construc-tion	Consump-tion	Investment
INPUT-OUTPUT TABLE										
Industry	40.0	40.0	90.0	30.0	120.0	200.0	0.2000	0.1250	0.4186	0.4615
Construction	40.0	120.0	125.0	35.0	160.0	320.0	0.2000	0.3750	0.5814	0.5385
Value added	120.0	160.0	0.0	0.0	0.0	280.0	0.6000	0.5000	0.0000	0.0000
Input	200.0	320.0	215.0	65.0	280.0	800.0	1.0000	1.0000	1.0000	1.0000
INVESTMENT										
Machinery	13.0	17.0	0.0	0.0	0.0	30.0	0.0650	0.0531	0.0000	0.0000
Buildings	9.0	26.0	0.0	0.0	0.0	35.0	0.0450	0.0813	0.0000	0.0000
Total	22.0	43.0	0.0	0.0	0.0	65.0	0.1100	0.1344	0.0000	0.0000
CAPITAL										
Machinery	100.0	120.0	0.0	0.0	0.0	40.0	0.5000	0.3750	0.0000	0.0000
Buildings	70.0	200.0	0.0	0.0	0.0	40.0	0.3500	0.6250	0.0000	0.0000
Total	170.0	320.0	0.0	0.0	0.0	40.0	0.8500	1.0000	0.0000	0.0000
LABOUR (1.000 Persons)										
Employees	1000	2800	0	0	0	3800	5.0000	8.7500	0.0000	0.0000

With the Leontief-matrix in Table 15.32 a complete system of input coefficients will be inverted which comprises intermediates and all primary inputs such as value added, capital (buildings, machinery) and labour in a mixed form of values and quantities. The three blocks of columns and rows refer to the three periods in time. The approach is equivalent to equation (91).

$$
\begin{array}{cccc}
\text{Period } t=0 & \text{Period } t=1 & \text{Period } t=2 & \\
\end{array}
$$

$$
\begin{bmatrix}
I-A & 0 & 0 & 0 & 0 & 0 \\
-B & I & 0 & 0 & 0 & 0 \\
0 & 0 & I-A & C & 0 & 0 \\
0 & 0 & -B & I & 0 & 0 \\
0 & 0 & -B & 0 & I-A & 0 \\
0 & 0 & 0 & 0 & -B & I
\end{bmatrix}
*
\begin{bmatrix}
x_1 \\ x_2 \\ x_1 \\ x_2 \\ x_1 \\ x_2
\end{bmatrix}
=
\begin{bmatrix}
y_1 \\ y_2 \\ c_1 \\ c_2 \\ c_1 \\ c_2
\end{bmatrix}
\begin{array}{l}
\text{Period } t=0 \\ \\ \text{Period } t=1 \\ \\ \text{Period } t=2 \\ \\
\end{array}
\qquad (104)
$$

Instead of integrating intermediate consumption with capital requirements in Matrix G = I – A + B, a separate treatment of all inputs seems to be more appropriate to trace the volatile dynamics of the model. It is well known from Keynesian multiplier and accelerator analysis that output levels are expected to fluctuate in a stable and unstable way depending on the parameters for marginal propensity to consume and capital requirements.

The unit matrix in the lower right corner of quadrant I refers to the corresponding requirements for primary inputs. The shaded elements in the following quadrants of the matrix reflect the endogenously derived capital requirements. The shaded elements of +1.0 and –1.0 refer to the interlinkages of capital requirements in the course of production, while the matrix C in equation 93 reflects the endogenous demand for capital goods (investment).

The inverse of the dynamic input-output model is presented in Table 15.34. It identifies in quadrant I the direct and indirect requirements for intermediates and primary inputs for the base year (Table 15.32). The following quadrants represent the corresponding requirements for the following two years including the endogenous results for primary inputs (value added, capital and labour). The results for capital will allow to derive the corresponding requirements for investment.

Table 15.35 presents the results of the dynamic input-output model. For the exogenous vector of final demand it is assumed that consumption is growing by 15 percent per year. Despite the stable results for this exercise it should be noted that dynamic input-output models react in a very volatile way to changes of capital coefficients, final demand structure and other input coefficients. It should be noted that the final demand vector in the base year t = 0 comprises consumption and investment. In the following years t = 1 and t = 2 the final demand vector only includes consumption as investment and from then onwards is an endogenous variable.

Table 15.33: Leontief matrix

	Industry	Construction	Value added	Machinery	Buildings	Employees	Industry	Construction	Value added	Machinery	Buildings	Employees	Industry	Construction	Value added	Machinery	Buildings	Employees
Industry	0.80	-0.13	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Construction	-0.20	0.63	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Value added	-0.60	-0.50	1.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	-0.50	-0.38	0.00	1.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Buildings	-0.35	-0.63	0.00	0.00	1.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Employees	-5.00	-8.75	0.00	0.00	0.00	1.00	0	0	0	0	0	0	0	0	0	0	0	0
Industry	0.50	0.38	0.00	0.00	0.00	0.00	0.80	-0.13	0.00	-1.00	0.00	0.00	0	0	0	0	0	0
Construction	0.35	0.63	0.00	0.00	0.00	0.00	-0.20	0.63	0.00	0.00	-1.00	0.00	0	0	0	0	0	0
Value added	0.00	0.00	0.00	0.00	0.00	0.00	-0.60	-0.50	1.00	0.00	0.00	0.00	0	0	0	0	0	0
Machinery	0.00	0.00	0.00	0.00	0.00	0.00	-0.50	-0.38	0.00	1.00	0.00	0.00	0	0	0	0	0	0
Buildings	0.00	0.00	0.00	0.00	0.00	0.00	-0.35	-0.63	0.00	0.00	1.00	0.00	0	0	0	0	0	0
Employees	0.00	0.00	0.00	0.00	0.00	0.00	-5.00	-8.75	0.00	0.00	0.00	1.00	0	0	0	0	0	0
Industry	0	0	0	0	0	0	0.50	0.38	0.00	0.00	0.00	0.00	0.80	-0.13	0.00	-1.00	0.00	0.00
Construction	0	0	0	0	0	0	0.35	0.63	0.00	0.00	0.00	0.00	-0.20	0.63	0.00	0.00	-1.00	0.00
Value added	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	-0.60	-0.50	1.00	0.00	0.00	0.00
Machinery	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	-0.50	-0.38	0.00	1.00	0.00	0.00
Buildings	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	-0.35	-0.63	0.00	0.00	1.00	0.00
Employees	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	-5.00	-8.75	0.00	0.00	0.00	1.00

Table 15.34: Inverse

	Industry	Construction	Value added	Machinery	Buildings	Employees	Industry	Construction	Value added	Machinery	Buildings	Employees	Industry	Construction	Value added	Machinery	Buildings	Employees
Industry	1.32	0.26	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Construction	0.42	1.68	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Value added	1.00	1.00	1.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Machinery	0.82	0.76	0.00	1.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Buildings	0.72	1.14	0.00	0.00	1.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Employees	10.26	16.05	0.00	0.00	0.00	1.00	0	0	0	0	0	0	0	0	0	0	0	0
Industry	1.32	2.08	0.00	0.00	0.00	0.00	0.00	-1.82	0.00	0.00	-1.82	0.00	0	0	0	0	0	0
Construction	2.42	2.78	0.00	0.00	0.00	0.00	-2.00	-1.09	0.00	-2.00	-1.09	0.00	0	0	0	0	0	0
Value added	2.00	2.64	0.00	0.00	0.00	0.00	-1.00	-1.64	1.00	-1.00	-1.64	0.00	0	0	0	0	0	0
Machinery	1.57	2.08	0.00	0.00	0.00	0.00	-0.75	-1.32	0.00	0.25	-1.32	0.00	0	0	0	0	0	0
Buildings	1.97	2.46	0.00	0.00	0.00	0.00	-1.25	-1.32	0.00	-1.25	-0.32	0.00	0	0	0	0	0	0
Employees	27.76	34.69	0.00	0.00	0.00	0.00	-17.50	-18.64	0.00	-17.50	-18.64	1.00	0	0	0	0	0	0
Industry	4	4	0	0	0	0	-2.27	-2.40	0.00	-2.27	-2.40	0.00	0.00	-1.82	0.00	0.00	-1.82	0.00
Construction	5	7	0	0	0	0	-2.86	-4.07	0.00	-2.86	-4.07	0.00	-2.00	-1.09	0.00	-2.00	-1.09	0.00
Value added	5	6	0	0	0	0	-2.80	-3.48	0.00	-2.80	-3.48	0.00	-1.00	-1.64	1.00	-1.00	-1.64	0.00
Machinery	4	5	0	0	0	0	-2.21	-2.73	0.00	-2.21	-2.73	0.00	-0.75	-1.32	0.00	0.25	-1.32	0.00
Buildings	5	6	0	0	0	0	-2.59	-3.39	0.00	-2.59	-3.39	0.00	-1.25	-1.32	0.00	-1.25	-0.32	0.00
Employees	64	82	0	0	0	0	-36.42	-47.63	0.00	-36.42	-47.63	0.00	-17.50	-18.64	0.00	-17.50	-18.64	1.00

Table 15.35: Input-output model

	Consumption	Investment	Final demand	Output
Industry	90.0	30.0	120.0	200.0
Construction	125.0	35.0	160.0	320.0
Value added	0.0	0.0	0.0	280.0
Machinery	0.0	0.0	0.0	220.0
Buildings	0.0	0.0	0.0	270.0
Employees	0.0	0.0	0.0	3800.0
Industry	103.5	0.0	103.5	229.5
Construction	143.8	0.0	143.8	370.7
Value added	0.0	0.0	0.0	323.1
Machinery	0.0	0.0	0.0	253.8
Buildings	0.0	0.0	0.0	312.0
Employees	0.0	0.0	0.0	4391.6
Industry	119.0	0.0	119.0	266.8
Construction	165.3	0.0	165.3	429.6
Value added	0.0	0.0	0.0	374.9
Machinery	0.0	0.0	0.0	294.5
Buildings	0.0	0.0	0.0	361.9
Employees	0.0	0.0	0.0	5093.1

Growth rate for consumption 15 percent per year

Table 15.36: Input-output tables for year t = 1 and year t = 2

	Industry	Construc-tion	Con-sumption	Invest-ment	Final demand	Output	Industry	Construc-tion	Con-sumption	Invest-ment	Final demand	Output
	Millions of Euro						Annual growth rates in percent					
Input-output table of year t = 1												
INPUT-OUTPUT TABLE												
Industry	45.9	46.3	103.5	33.8	137.3	229.5	14.8	15.9	15.0	12.7	14.4	14.8
Construction	45.9	139.0	143.8	42.0	185.8	370.7	14.8	15.9	15.0	20.1	16.1	15.9
Value added	137.7	185.4	0.0	0.0	0.0	323.1	14.8	15.9	-	-	-	15.4
Input	229.5	370.7	247.3	75.8	323.1	923.4	14.8	15.9	15.0	16.7	15.4	15.4
INVESTMENT												
Machinery	14.8	19.0	0.0	0.0	0.0	33.8	13.6	11.9	-	-	-	12.7
Buildings	10.3	31.7	0.0	0.0	0.0	42.0	14.9	21.9	-	-	-	20.1
Total	25.1	50.7	0.0	0.0	0.0	75.8	14.2	18.0	-	-	-	16.7
CAPITAL												
Machinery	114.8	139.0	0.0	0.0	0.0	253.8	14.8	15.9	-	-	-	15.4
Buildings	80.3	231.7	0.0	0.0	0.0	312.0	14.8	15.9	-	-	-	15.6
Total	195.1	370.7	0.0	0.0	0.0	565.8	14.8	15.9	-	-	-	15.5
LABOUR (1.000 Persons)												
Employees	1148	3244	0	0	0	4392	14.8	15.9	-	-	-	15.6

Input-output table of year t = 2												
INPUT-OUTPUT TABLE												
Industry	53.4	53.7	119.0	40.7	159.7	266.8	16.2	15.9	15.0	20.4	16.3	16.2
Construction	53.4	161.1	165.3	49.8	215.2	429.6	16.2	15.9	15.0	18.5	15.8	15.9
Value added	160.1	214.8	0.0	0.0	0.0	374.9	16.2	15.9	-	-	-	16.0
Input	266.8	429.6	284.3	90.5	374.9	1071.3	16.2	15.9	15.0	19.4	16.0	16.0
INVESTMENT												
Machinery	18.6	22.1	0.0	0.0	0.0	40.7	26.0	16.1	-	-	-	20.4
Buildings	13.0	36.8	0.0	0.0	0.0	49.8	26.0	16.1	-	-	-	18.5
Total	31.7	58.9	0.0	0.0	0.0	90.5	26.0	16.1	-	-	-	19.4
CAPITAL												
Machinery	133.4	161.1	0.0	0.0	0.0	294.5	16.2	15.9	-	-	-	16.0
Buildings	93.4	268.5	0.0	0.0	0.0	361.9	16.2	15.9	-	-	-	16.0
Total	226.8	429.6	0.0	0.0	0.0	656.4	16.2	15.9	-	-	-	16.0
LABOUR (1.000 Persons)												
Employees	1334	3759	0	0	0	5093	16.2	15.9	-	-	-	16.0

The main results of the dynamic input-output model are summarised in Tables 15.36. The projected input-output tables include all required information on investment and capital. For simplicity, the requirements for capital consumption have been neglected. It should be noted that for each input-output Table an investment matrix has been derived as a bridge between producers of capital goods and investors.

The dynamics of economic growth for the economy is induced by consumption which is expected to grow by 15 percent per year. In our example this growth induces investment and primary inputs for value added (consumption of fixed capital, net taxes on products, compensation of employees, operating surplus), labour (employees, self-employed) and capital (buildings, machinery) in the range of the anticipated growth rate for consumption.

The main benefit of a dynamic input-output model is the potential to provide a consistent framework for production and investment, capital and labour requirements for economic development in time.

Volatility of dynamic input-output models

To avoid the vicious fluctuations and implausible results of dynamic input-output models, a different approach has been implemented to analyse the economic impacts of the Structural Funds of the European Commission (Beutel 2002). In this case induced investment is a function of actual growth of specific exogenous final demand components such as consumption and exports, but not of investment.

(104) $X_t = AX_t + C_t + I_t$
(105) $Z = (I\text{-}A)^{-1}$
(105) $I_t = B(ZC_t - ZC_{t-1})$
(106) $X_t = AX_t + C_t + B(ZC_t - ZC_{t-1})$
(107) $X_t = Z\{C_t + BZ[C_t - C_{t-1}]\}$

Important contributions to dynamic input-output models are included in Leontief (Leontief 1970), Schumann (Schumann 1968) and Meyer (Meyer 1980). Interesting empirical applications of dynamic input-output models have been implemented in the studies of Leontief and Duchin (Leontief and Duchin 1984) and Kalmbach and Kurz (Kalmbach and Kurz 1990).

15.2.4 Other input-output models

A few other important input-output models and general equilibrium models are presented in this chapter to demonstrate that a disagregated input-output data base is an essential feature of many modern macroeconomic models.

The Inforum approach to interindustry modelling

INFORUM models were initiated by Clopper Almon (Almon 1991) at the University of Maryland. The name stands for “Interindustry Forecasting at the University of Maryland”. INFORUM models are internationally linkable, dynamic, interindustry models which imitates as closely as the economy behaves. They are intended for both public policy analysis and business forecasting. The models are contrasted with classical input-output models, pure econometric models and computable general equilibrium models. Where appropriate, the model uses regression analysis to describe the behaviour of consumers, producers, exporters, importers, investors, or other economic decision makers. It uses explicit and usually changing input-output relations among industries. That use assures absolute accounting consistency, on the production side, among final demands, intermediate use, and production of products and, on the price side, among prices of products, the costs of materials used and the value-added generating in making them.

An INFORUM model does not rely upon ex-post scaling to produce reasonable forecasts, though it may explicitly show statistical discrepancies necessitated by conflicting official data. It builds up macroeconomic totals, like gross domestic product, from industry level variables. It does not start with aggregate totals and spread them to industries. The model traces the development of the economy over time and may definitely show business cycles. It does not concentrate on an equilibrium condition at some future date. Finally, the model of one country needs to be linkable with similar models of other countries.

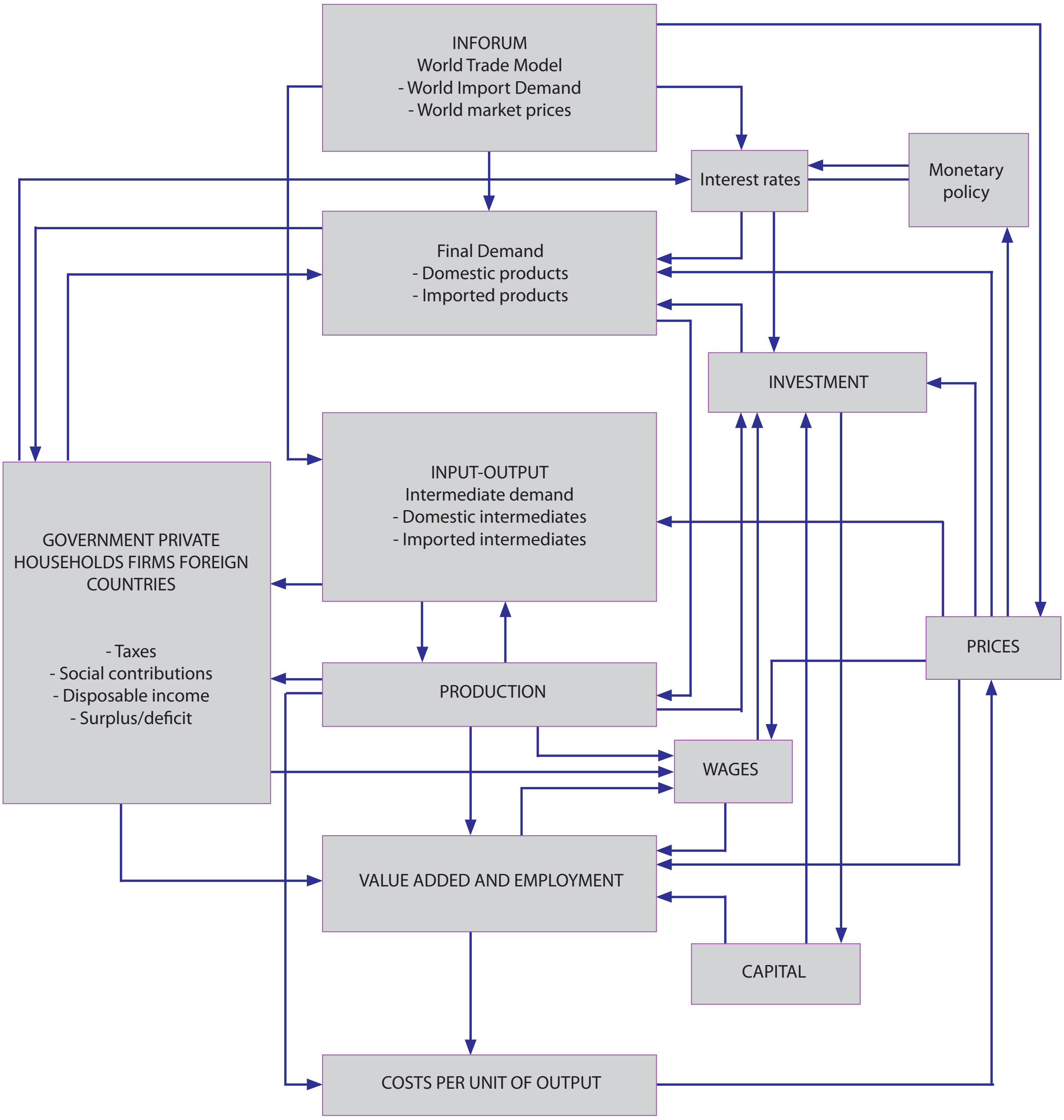
The model may start as simple as just a constant input-output table and exogenous final demand and grow into a model that integrates output, prices, incomes, changing technical coefficients, and dynamic investment functions. There is no attempt to determine centrally the form of the behavioural functions used. This group of characteristics seem simple, yet it distinguishes this group of models from numerous others. The following list of other models shows how they differ from INFORUM models.

- The classical econometric models make little or no use of input-output tables, but rely heavily on regression analysis even for relating industry outputs to final demand aggregates.
- Classical input-output models make little or no use of regression-based behavioural equations. If they are dynamic, investment is based on capital requirements for future growth, not on any study why firms would actually invest. This requirements approach makes current investment depend on future planned output, a dependency which often leads to severe instability problems of the model results.
- Computable general equilibrium models have concentrated on equilibrium positions rather than on a dynamic time path of an economy that has business cycles and may never be in a steady state or equilibrium. Computable general equilibrium models are usually conducted in the framework of a social accounting matrix (SAM).

INFORUM models use input-output tables with variable input coefficients both in the computation of industry outputs and industry prices. They rely heavily on regression-based econometrics for behavioural equations, especially for consumption, investment, export, import, productivity, profits and wages. The behavioural approach to investment completely eliminates the instability of dynamic input-output models. A complete INFORUM model has all the non-zero element of a social accounting matrix but avoids large all-zero matrices and the implementation of the ‘industry technology’ assumption. The SAM also seems to breed a certain complacency with in the input-output calculations. In the insistence on a complete accounting system and in considering both income and prices effects, the computable general equilibrium models resemble the models of the INFORUM family.

Numerous input-output models use aggregate macro-model drivers. The DRI input-output models are well-known commercial examples. However, the technique used in this model destroys the consistency with the original control totals. The HERMES models were initiated by the European Commission and have inverted the INFORUM approach to international cooperation. The sectoring plans and the functional forms of the national models were centrally specified and in advance of the actual model building. The complicated structure of the model and the substantial requirements for updating the data base become a more serious challenge for these models. The CAMBRIDGE ECONOMETRICS model of the United Kingdom has all the properties of a model of the INFORUM family but is built with different software, a fact which has made international linkage difficult.

Figure 15.1: Flow chart of the INFORGE Model



The same accounting structure is common to all the INFORUM models and is built into the common software, though it can be modified to suit particular countries. There is, however, no attempt to make econometrics within the various models uniform. Functional forms and estimation techniques may be different in different countries. Nor need the sectoring plans of the tables or their base year be common. The best available information in each country should be used. The concern is to make it as easy as possible for economists in the national partner groups to concentrate on economics rather than software to build up the best possible model for each country.

The Interindustry Forecasting Models for Germany

Bernd Meyer has developed the Model INFORGE as a member of the INFORUM international system. This consortium was initiated by Clopper Almon and comprises today 14 national models. All models are linked at a deep level of sectoral disaggregation with each other through a world trade model. The international system covers in an endogenous way approximately 90 percent of world trade and 85 percent of world gross domestic production. The name INFORGE was derived from "Interindustry Forecasting Germany".

The structure of the INFORGE model is presented in Figure 15.1. The INFORUM world trade model derives the vector of world import demand and the vector of world market prices for each commodity group and the US interest rate. In all branches 58 product groups are distinguished. For private consumption 26 different purposes and functions are defined, which are transformed into 58 product groups with the help of a bridge matrix. An investment matrix allows linking the column vectors for investment in buildings and machinery of the producing sectors with the row vector of investment for the investing branches. All components of final demand and the demand for intermediates are endogenous variables. The input coefficients for intermediate and import shares are variable, depending on changes of relative prices. The demand of the various branches for the primary inputs labour and capital depends on wages, interest rates, and prices for intermediate inputs and output (products).

A special feature of the INFORGE model is the deep extent of disaggregation (58 branches) and the derivation of a full and consistent set of national accounts for the main institutions (firms, private households, government services, foreign countries). For each institution seven separate accounts are distinguished, among them the production account, the generation of income account, the allocation of primary income account, and the distribution of income account. The linkage between the disaggregated data and macro data is controlled by explicit aggregation of all transactions and integration in to the system of national accounts. In a recursive manner the macroeconomic results, as reflected in the system of accounts, can provide feedback on the disaggregate level of the data base.

Summarising the main features of INFORGE (Meyer and Ewerhart 1998), the model can be said to reflect the structural change of the world economy. However, the main objective of the approach is to model the structural change in Germany. This is achieved by the treatment of supply and demand of products (goods and services) as endogenous variables and a proper reflection of the interdependency between macroeconomic development and individual decisions.

With PANTA RHEI (Meyer 1998) an ecologically extended version of the 58 sector econometric simulation and forecasting model INFORGE was established with 29 energy carriers for macroeconomic policy applications, in particular the introduction of a carbon tax. A full description of the model and its application was published in 1998 (Meyer, Bockermann, Ewerhart and Lutz 1998).

International Comparisons of Productivity

The EU KLEMS project aims to create a database on measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level for all European Union member states from 1970 onwards. This work will provide an important input to policy evaluation, in particular for the assessment of the goals concerning competitiveness and economic growth potential as established by the Lisbon and Barcelona summit goals. The database should facilitate the sustainable production of high quality statistics using the methodologies of national accounts and input-output analysis. The input measures will include various categories of capital, labour, energy, material and service inputs. Productivity measures will be developed, in particular with growth accounting techniques. Several measures on knowledge creation will also be constructed. Substantial methodological and data research on these measures will be carried out to improve international comparability. There will be ample attention for the development of a flexible database structure, and for the progressive implementation of the database in official statistics over the course of the project. The database will be used for analytical and policy-related purposes, in particular by studying the relationship between skill formation, technological progress and innovation on the one hand, and productivity, on the other. To facilitate this type of analysis, a link will also be sought with existing micro (firm level) databases. The balance in academic, statistical and policy input in this project is realised by the participation of 15 organisations from across the EU, representing a mix of academic institutions and national economic policy research institutes and with the support from various statistical offices and the OECD.

The consortium was initiated by Dale Jorgenson of Harvard University and the University of Groningen. The EU KLEMS project is co-ordinated by the Groningen Growth and Development Centre of the University of Groningen in collaboration with the National Institute of Economic and Social Research in London. The consortium comprises 18 partners of scientific institutions of the European Union. The initiative is supported by the OECD which prepared the "OECD Manual on Productivity Measurement".

The EU KLEMS Project is funded by the European Commission, Research Directorate General as part of the 6th Framework Programme, Priority 8, "Policy Support and Anticipating Scientific and Technological Needs".

EXIOPOL is an integrated project that aims to develop estimates of external costs of a broad set of economic activities for Europe and to set up a detailed environmentally extended input-output framework including these estimates, in order to apply the results of this analysis to address policy questions. The project is co-ordinated by the Fondazione Eni Enrico Mattei (FEEM) in collaboration with The Netherlands Organisation for Applied Scientific Research (TNO). EXIOPOL involves 37 partners both from inside and outside of Europe. Partners have been selected for having a sound experience in two main research fields: the valuation of the external costs of key environmental impacts, and environmentally extended input-output analysis.

The EXIOPOL Project has 3 main objectives:

1. to synthesise and develop comprehensive estimates of the external costs for Europe of a broad set of economic activities;
2. to set up a detailed environmentally extended input-otput framework, with links to other socio-economic models, in which as many of these estimates as possible are included. Such an environmentally extended input-output table for the EU 25 does not exist. This will allow for the estimation of environmental impacts and external costs of different economic sector activities, final consumption activities and resource consumption for countries in the EU;
3. to apply the results of the external cost estimates and environmentally extended input-output analysis for the analysis of policy questions of importance, as well as to evaluate the impact of past research on external costs on policy-making in the EU.

The integrated project will create a novel toolbox supportive of a great variety of EU policy fields, such as Integrated Product Policy, the Strategy on Natural Resources, the Environmental Technologies Action Plan, Sustainable Consumption and Production, the relation between sustainability and the Lisbon strategy, and impact assessment of related policies in general.

The objectives reflect those of the Global Change and Ecosystem Work Programme (WP), which emphasises the importance of a quantitative analysis of external effects, and the elaboration of new accounting frameworks for sustainability assessment at the micro, sectoral and macro levels. As the WP requires, the structure and outputs of EXIOPOL are very much geared to provide a basis for these new policy analytical tools as well as to strengthen the existing tools of cost benefit and cost effectiveness analysis, and can also improve the full domain of economic-environmental modelling. This strengthening will come from better quantitative information on the external costs associated with resource use and a broad range of emissions of all economic activities that have hitherto not been analysed in detail.

The EXIOPOL Project is funded by the European Commission, Research Directorate General as part of the 6th Framework Programme, Priority 6, "Global Change and Ecosystems".

Economic Modelling in Norway

For many years, Norway has been among the leading nations concerning the quality of national accounts and the application of sophisticated macroeconomic models. All the macroeconomic models of Statistics Norway incorporate an input-output core.

Quarterly Macroeconomic Model KVAR

The Norwegian quarterly macroeconomic model KVARTS (Bowitz and Torbjorn 1989) is primarily used by Statistics Norway for regular short-term movements and forecasting purposes. Forecasts are published twice a year. A recent application of this model was initiated to study the impact of OPEC.

KVART contains about 1.300 equations and 600 exogenous variables. Its relatively large dimension, as far as the number of equations are concerned, is mainly dues to the relatively disaggregate specification of sectors and commodities. There are 17 sectors and 26 commodities. Like other Norwegian models developed by Statistics Norway, KVARTS integrates the *input-output structure* of the national accounts into the model structure. A substantial part of the equations are input-output-equations and definitional relationships. About 100 equations can be called econometric equations, i.e. specified stochastically and estimated by econometric methods.

KVARTS endogenises most variables in the real sphere of the economy as well as wages and prices. Import prices in local currency are exogenous, also implying exogenous exchange rates. Furthermore, various financial variables, e.g. interest rates and supply of credit influencing household's demand, are exogenous variables.

Macroeconomic Model MODAG

The Norwegian annual MODAG model (Cappelen 1992) has been widely used for a range of issues over the last 20 years, mostly related to government demand and recently about the effects of a membership of Norway in the European Union. By international comparison it is worth noting that the trend in Norwegian large scale econometric model building has been a move towards more aggregated models. While MODIS IV had 200 commodities, the MODAG-models specify around 40 commodities. Still, by international standards, MODAG is a fairly disaggregated model. Large scale models in most countries have moved in the opposite direction, from being highly aggregated to becoming more disaggregated.

Although supply-side factors have become more important, as new model blocks have been added to the model, the main use of MODAG is still in preparing short and medium term policy documents for the Norwegian parliament. In this setting, demand management and income policy still play an important role.

MODAG is an *input-output based model* which is used in short- and medium-term macroeconomic planning and policy analysis. MODAG is influenced by the Scandinavian model of inflation, with its distinction between exposed and sheltered commodity markets, by Keynesian macroeconomic theory and by input-output modelling.

The Norwegian national accounting system forms the conceptual framework and the empirical basis of the model. Nearly all parameters of the various submodels are estimated econometrically from national accounts time series, whereas the coefficients of the input-output structure are estimated from national accounts for the base year of the model.

The model is rebased every year, with the base year normally lagging two years behind the current year. The description of the commodity flows is one of the main elements of MODAG. Just as in the national accounts, commodity transactions are represented by means of two commodity-by-sector matrices, one for the flow of commodities to each sector and one for the flow of commodities from each sector. MODAG has 40 commodities, 28 production sectors and 14 categories of private consumption. Real capital and investments are generally grouped in 3 categories for each of the production sectors.

General Equilibrium Model MSG

The Norwegian MSG model (Holmoy 1992), abbreviated from Multi Sectoral Growth, is an applied general equilibrium model (AGE) that has been regularly used in long-term planning by the Norwegian Ministry of Finance since 1968. During these years four major revisions have been made of the original MSG model. The latest example of using MSG for long-term projections was the analysis of the impacts of a climate convention on the Norwegian economy.

The MSG model has a long perspective. Therefore, it is more important to incorporate mechanisms explaining long-term trends than short-term fluctuations in the economy. Consequently the natural choice for the applied researcher is to base the model on the theory of economic growth which is a special discipline of general equilibrium theory. Contrary to typical macro-econometric models in the Keynes-Klein tradition, the driving forces of growth in the macroeconomic aggregates are expansion of the endowments of primary input factors in the production process. It seems that the underlying trends around which the economy fluctuates are better explained by general equilibrium theory than any other theoretical framework presently available for implementation in a numerical large-scale model. The major strength of an AGE model is its solid theoretical foundation. Behaviour of agents is explicitly modelled and is based on microeconomic optimisation principles

Internationally, AGE models are mostly used for quantitative welfare analysis of policy measures. Especially, assessing the welfare gains of tax reforms or trade liberalisation have been popular subjects for analysis. Like most AGE models, no version of MSG has been a complete general equilibrium (GE) model in a strict sense. A complete GE model is made up by relations derived from rational, competitive behaviour of all agents, combined with the assumption of flexible relative prices clearing all markets. Compared to such a GE model, intertemporal behaviour of households is not built into the

MSG-5. Instead, private consumption is determined from the supply side, restricted by the total supply of labour. On the other hand, producer behaviour is derived from intertemporal optimising behaviour.

The model specifies 40 commodities. Except from 8 non-competing imports and 4 public goods, each commodity is a composite good, i.e. an aggregate of a domestic and a foreign variety. 28 production sectors are specified. In general each sector produces several commodities, but in fixed proportions corresponding to the description given by the National Accounts in the base year. The demand for inputs follows a two stage budgeting procedure. At the "top" level there are four input factors, labour (man-hours), capital, energy and other material inputs. These factors are optimally combined according to a constant-returns-to-scale technology which may shift over time through Hicks-neutral technical change. The technology is represented in dual terms by generalised Leontief cost functions. At the "bottom" level, demand for energy is further divided into electricity and fuels according to a constant returns CES production function.

The capital stock in each sector is a sector specific Leontief-aggregate of 8 capital goods. Each of these capital goods are aggregates of the 40 basic composite commodities in the model. Also material inputs, electricity and fuels in each sector are sector specific aggregates of the 40 basic composite commodities.

Multi-sectoral Economic Models for Japan

The Economic Planning Agency of Japan developed "Multi-Sectoral Models for Medium and Long-term Analysis" (Economic Planning Agency 1999) which use an input-output data base.

Medium-Term Multi-Sectoral Model

The "Medium-Term Multi-Sectoral Model" is a semi-annual econometric model designed to describe the behaviour of economic units disaggregated, according to the System of National Accounts (SNA), in terms both of institutional sectors (households, firms, government) and kind of economic activities (industrial sectors). The model deals with all the major accounting tables, i.e. supply and use tables, income and outlay by institutional sectors, financial transactions, employed persons by kind of economic activity and stock of tangible and financial assets.

Major features of the model are:

- Disaggregation of 15 commodities (goods and services) and 14 sectors
- Dynamic accumulation of productive capital stock through investment
- Neoclassical production function for each sector
- Demand function for each institutional sector
- No instantaneous adjustment of supply and demand

The model can be characterised as a multi-sectoral dynamic disequilibrium model.

Long-Term Multi-Sectoral Model

The "Long-Term Multi-Sectoral Model" is a *dynamic input-output model* designed to explore an optimal and realistic growth path of the Japanese economy in the long run. The model has turnpike theorems as its background theory. Thus, the characteristic of its solution sharply contrasts with that of an econometric model projection. It is assumed that a unique balanced growth path (turnpike) exists if precise information of available technology, consumer's preferences, and national consensus on the broad outline of economic future is known.

The model has 33 economic activities (industrial sectors). The data consists of input-output relations between these sectors, a productive capital stock matrix by sector and final demand components disaggregated by commodity. The objective function to be maximised in the model is based on utility defined on consumption and the flow of benefits from non-productive stocks. The production function with factor substitution is approximated by a linear combination of more than one production processes which are of perfect complementary type. Capital stocks are assumed to be inconvertible from one sector to the other. The model is solved by linear programming.

The model enables to investigate

- the optimal and feasible growth rate and induced structural change,
- the impact of technological progress on growth and structural change,
- the extent to which the growth path is affected by changes in growth-constraining factors, and
- the effects of commodity composition of final demand components on growth and structure.

Outlook

A macroeconomic model is a logical, mathematical and computational framework designed to describe the operation of an economy. It portrays the dynamics of aggregate quantities such as the total amount of goods and services supplied by domestic production and imports, total income earned, the level of employment of productive resources, and the level of prices. There are different types of macroeconomic models that serve different purposes and have different advantages and disadvantages. Macroeconomic models are used to clarify and illustrate basic theoretical principles in macroeconomics. They are used to test, compare and quantify different macroeconomic theories about the economy. Often they are employed to evaluate the possible effects of changes in fiscal, monetary, employment or other macroeconomic policies. They are also used for generating economic forecasts.

Supply and use tables and input-output tables constitute the database of many macroeconomic models. They also give a careful disaggregated view of the main macroeconomic variables and the interdependency in production. It is the objective of this manual to explain how supply and use tables and input-output tables can be compiled from statistical sources and survey results. It is also the intention of the manual to help harmonise the methodologies which are used in the European Union to compile the main macroeconomic data. Insofar, the Eurostat input-output manual is a complement to the ESA 1995.

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Glossary

GLOSSARY

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Additivity

Additivity is a property pertaining to a set of interdependent index numbers related by definition or by accounting constraints under which an aggregate is defined as the sum of its components; additivity requires this identity to be preserved when the values of both an aggregate and its components in some reference period are extrapolated over time using a set of volume index numbers.

Base period

The period that provides the weights for an index is described as the base period.

Basic price

The basic price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, and plus any subsidy receivable, on that unit as a consequence of its production or sale; it excludes any transport charges invoiced separately by the producer.

CIF price

The CIF price (i.e. cost, insurance and freight price) is the price of a good delivered at the frontier of the importing country, including any insurance and freight charges incurred to that point, or the price of a service delivered to a resident, before the payment of any import duties or other taxes on imports or trade and transport margins within the country; in SNA 1993 this concept is applied only to detailed imports.

Capital stock - gross

Gross capital stock is the value of all fixed assets still in use at the actual or estimated current purchasers' prices for new assets of the same type, irrespective of the age of the assets.

Capital stock - net

The sum of the written-down values of all the fixed assets still in use is described as the net capital stock; it can also be described as the difference between gross capital stock and consumption of fixed capital.

Central product classification (CPC)

The central product classification (CPC) is a classification based on the physical characteristics of goods or on the nature of the services rendered; each type of good or service distinguished in the CPC is defined in such a way that it is normally produced by only one activity as defined in ISIC.

Chain linked indices

Chain linked indices are obtained by linking price (or volume) indices for consecutive periods; the short-term movements which are linked are calculated using weighting patterns appropriate to the periods concerned.

Changes in inventories

Changes in inventories (including work-in-progress) consist of changes in: (a) stocks of outputs that are still held by the units that produced them prior to their being further processed, sold, delivered to other units or used in other ways; and (b) stocks of products acquired from other units that are intended to be used for intermediate consumption or for resale without further processing; they are measured by the value of the entries into inventories less the value of withdrawals and the value of any recurrent losses of goods held in inventories.

Classification of individual consumption by purpose (COICOP)

The classification of individual consumption by purpose (COICOP) is a classification used to identify the objectives of both individual consumption expenditure and actual individual consumption.

Classification of outlays of producers by purpose (COPP)

The classification of outlays of producers by purpose (COPP) is used to classify expenditures by producers (intermediate consumption, compensation of employees, etc) by purpose (e.g. outlays on repair and maintenance or outlays on sales promotion).

Classification of the functions of government (COFOG)

The classification of the functions of government (COFOG) is a classification used to identify the socio-economic objectives of current transactions, capital outlays and acquisition of financial assets by general government and its sub-sectors.

Classification of the purposes of non-profit institutions (COPNI)

The classification of the purposes of non-profit institutions (COPNI) is a classification used to identify the socio-economic objectives of current transactions, capital outlays and acquisition of financial assets by non-profit institutions serving households.

COFOG (classification of the functions of government)

COFOG (classification of the functions of government) is a classification used to identify the socio-economic objectives of current transactions, capital outlays and acquisition of financial assets by general government and its sub-sectors.

COICOP (classification of individual consumption by purpose)

COICOP (classification of individual consumption by purpose) is a classification used to identify the objectives of both individual consumption expenditure and actual individual consumption.

Compensation of employees

Compensation of employees is the total remuneration, in cash or in kind, payable by an enterprise to an employee in return for work done by the latter during the accounting period.

Constant prices

Constant prices are obtained by directly factoring changes over time in the values of flows or stocks of goods and services into two components reflecting changes in the prices of the goods and services concerned and changes in their volumes (i.e. changes in "constant price terms"); the term "at constant prices" commonly refers to series which use a fixed-base Laspeyres formula.

Consumption of fixed capital

Consumption of fixed capital represents the reduction in the value of the fixed assets used in production during the accounting period resulting from physical deterioration, normal obsolescence or normal accidental damage.

COPNI (classification of the purposes of non-profit institutions)

COPNI (classification of the purposes of non-profit institutions) is a classification used to identify the socio-economic objectives of current transactions, capital outlays and acquisition of financial assets by non-profit institutions serving households.

COPP (classification of outlays of producers by purpose)

COPP (classification of outlays of producers by purpose) is used to classify expenditures by producers (intermediate consumption, compensation of employees, etc) by purpose (e.g. outlays on repair and maintenance or outlays on sales promotion).

Corporation

A corporation is a legal entity, created for the purpose of producing goods or services for the market that may be a source of profit or other financial gain to its owner(s); it is collectively owned by shareholders who have the authority to appoint directors responsible for its general management.

CPA (Statistical Classification of Products by Activity in the European Economic Community)

The CPA is the European version of the CPC. Whilst the CPC is merely a recommended classification, the CPA is legally binding in the European Community.

CPC (central product classification)

The CPC (central product classification) is a classification based on the physical characteristics of goods or on the nature of the services rendered; each type of good or service distinguished in the CPC is defined in such a way that it is normally produced by only one activity as defined in ISIC.

Current account (balance of payments)

The current account (balance of payments) shows details of goods and services, income, and current transfers.

Current cost accounting

Current cost accounting is a valuation method whereby assets and goods used in production are valued at their actual or estimated current market prices at the time the production takes place (it is sometimes described as "replacement cost accounting").

Current transfers

Current transfers consist of all transfers that are not transfers of capital; they directly affect the level of disposable income and should influence the consumption of goods or services.

Deductible VAT

Deductible VAT (value added tax) is the VAT payable on purchases of goods or services intended for intermediate consumption, gross fixed capital formation or for resale which a producer is permitted to deduct from his own VAT liability to the government in respect of VAT invoiced to his customers.

Depreciation

Depreciation as usually calculated in business accounts is a method of allocating the costs of past expenditures on fixed assets over subsequent accounting periods; note that the depreciation methods favoured in business accounting and those prescribed by tax authorities almost invariably deviate from the concept of consumption of fixed capital employed in the SNA and so the term "consumption of fixed capital" is used in the SNA to distinguish it from "depreciation" as typically measured in business accounts.

Disposals

Disposals of assets (inventories, fixed assets or land or other non-produced assets) by institutional units occur when one of those units sells or transfers any of the assets to another institutional unit; when the ownership of an existing fixed asset is transferred from one resident producer to another, the value of the asset sold, bartered or transferred is recorded as negative gross fixed capital formation by the former and as positive gross fixed capital formation by the latter.

Double deflation

Double deflation is a method whereby gross value added is measured at constant prices by subtracting intermediate consumption at constant prices from output at constant prices; this method is feasible only for constant price estimates which are additive, such as those calculated using a Laspeyres' formula (either fixed-base or for estimates expressed in the previous year's prices).

Dwellings

Dwellings are buildings that are used entirely or primarily as residences, including any associated structures, such as garages, and all permanent fixtures customarily installed in residences; movable structures, such as caravans, used as principal residences of households are included.

Economic flows

Economic flows reflect the creation, transformation, exchange, transfer or extinction of economic value; they involve changes in the volume, composition, or value of an institutional unit's assets and liabilities.

Employee

An employee is a person who enters an agreement, which may be formal or informal, with an enterprise to work for the enterprise in return for remuneration in cash or in kind.

Employees' social contributions

Employees' social contributions are the amounts payable by employees to social security funds and private funded social insurance schemes.

Employers' social contributions

Employers' social contributions are payments by employers which are intended to secure for their employees the entitlement to social benefits should certain events occur, or certain circumstances exist, that may adversely affect their employees' income or welfare - sickness, accidents, redundancy, retirement, etc.

Enterprise

An enterprise is an institutional unit in its capacity as a producer of goods and services; an enterprise may be a corporation, a quasi-corporation, a non-profit institution, or an unincorporated enterprise.

Establishment

An establishment is an enterprise or part of an enterprise that is situated in a single location and in which only a single (non-ancillary) productive activity is carried out or in which the principal productive activity accounts for most of the value added.

Excise duties

Excise duties consist of special taxes levied on specific kinds of goods, typically alcoholic beverages, tobacco and fuels; they may be imposed at any stage of production or distribution and are usually assessed by reference to the weight or strength or quantity of the product.

Export duties

Export duties consist of general or specific taxes on goods or services that become payable when the goods leave the economic territory or when the services are delivered to non-residents; profits of export monopolies and taxes resulting from multiple exchange rates are excluded.

Export subsidies

Export subsidies consist of all subsidies on goods and services that become payable to resident producers when the goods leave the economic territory or when the services are delivered to non-resident units; they include direct subsidies on exports, losses of government trading enterprises in respect of trade with non-residents, and subsidies resulting from multiple exchange rates.

Export taxes

Export taxes are taxes on goods or services that become payable when the goods leave the economic territory or when the services are delivered to non-residents; they include export duties, profits of export monopolies and taxes resulting from multiple exchange rates.

Exports of goods

Exports of goods consist of exports of the following items from residents to non-residents: generally with a change of ownership being involved: general merchandise, goods for processing, goods procured in domestic ports by non-resident carriers and non-monetary gold.

Exports of services

Exports of services consist of exports of the following services provided by residents to non-residents: transportation; travel; communications; construction; insurance; financial; computer and information; royalties and licence fees; other business services; personal, cultural, and recreational services; and government services n.i.e.

FOB price

The FOB price (free on board price) of exports and imports of goods is the market value of the goods at the point of uniform valuation, (the customs frontier of the economy from which they are exported); it is equal to the CIF price less the costs of transportation and insurance charges, between the customs frontier of the exporting (importing) country and that of the importing (exporting) country.

Factor cost

Gross value added at factor cost is not a concept used explicitly in the SNA but it can easily be derived by subtracting the value of any taxes, less subsidies, on production payable out of gross value added.

Final consumption

Final consumption consists of goods and services used up by individual households or the community to satisfy their individual or collective needs or wants.

Final consumption expenditure of government

Government final consumption expenditure consists of expenditure, including imputed expenditure, incurred by general government on both individual consumption goods and services and collective consumption services.

Final consumption expenditure of households

Household final consumption expenditure consists of the expenditure, including imputed expenditure, incurred by resident households on individual consumption goods and services, including those sold at prices that are not economically significant.

Final consumption expenditure of NPISHs

Final consumption expenditure of NPISHs (non-profit institutions serving households) consists of the expenditure, including imputed expenditure, incurred by resident NPISHs on individual consumption goods and services.

Final expenditure

Final expenditure consists of final consumption expenditure and gross fixed capital formation.

Final use quadrant

The final use quadrant (of the "use table" in an input-output system) shows exports, final consumption expenditure and gross capital formation at purchasers' prices in the columns each classified by products in the rows.

Financial corporations

Financial corporations consist of all resident corporations or quasi-corporations principally engaged in financial intermediation or in auxiliary financial activities which are closely related to financial intermediation.

Financial intermediation

Financial intermediation is a productive activity in which an institutional unit incurs liabilities on its own account for the purpose of acquiring financial assets by engaging in financial transactions on the market; the role of financial intermediaries is to channel funds from lenders to borrowers by intermediating between them.

Financial intermediation services indirectly measured (FISIM)

Financial intermediation services indirectly measured (FISIM) is an indirect measure of the value of financial intermediation services provided but for which financial institutions do not charge explicitly.

Fisher's Ideal Index (price)

Fisher's Ideal price index is the geometric mean of the Laspeyres and Paasche price indices.

Fisher's Ideal Index (volume)

Fisher's Ideal volume index is the geometric mean of the Laspeyres and Paasche volume indices.

FISIM (financial intermediation services indirectly measured)

FISIM (financial intermediation services indirectly measured) is an indirect measure of the value of financial intermediation services provided but for which financial institutions do not charge explicitly.

Fixed assets

Fixed assets are tangible or intangible assets produced as outputs from processes of production that are themselves used repeatedly or continuously in other processes of production for more than one year.

Flows - economic

Economic flows reflect the creation, transformation, exchange, transfer or extinction of economic value; they involve changes in the volume, composition, or value of an institutional unit's assets and liabilities.

Flows in real terms

Many flows, such as cash transfers or gross operating surplus, do not have price and quantity dimensions of their own into which they can be decomposed so such flows cannot be measured at constant prices; however, they can be measured "in real terms" by deflating their values by price indices in order to measure their real purchasing power over some selected basket of goods and services that serves as numéraire.

Functional classifications

Functional classifications provide a means of classifying, by purpose or socio-economic objective, certain transactions of producers and of three institutional sectors - namely households, general government and non-profit institutions serving households (NPISHs).

General government

The general government sector consists of the totality of institutional units which, in addition to fulfilling their political responsibilities and their role of economic regulation, produce principally non-market services (possibly goods) for individual or collective consumption and redistribute income and wealth.

GNI (gross national income)

GNI (gross national income) is GDP less net taxes on production and imports, less compensation of employees and property income payable to the rest of the world plus the corresponding items receivable from the rest of the world (in other words, GDP less primary incomes payable to non-resident units plus primary incomes receivable from non-resident units); an alternative approach to measuring GNI at market prices is as the aggregate value of the balances of gross primary incomes for all sectors; (note that GNI is identical to gross national product (GNP) as previously used in national accounts generally).

Goods

Goods are physical objects for which a demand exists, over which ownership rights can be established and whose ownership can be transferred from one institutional unit to another by engaging in transactions on markets; they are in demand because they may be used to satisfy the needs or wants of households or the community or used to produce other goods or services.

Gross

The term “gross” is a common means of referring to values before deducting consumption of fixed capital (generally used as in “gross capital stock” or “gross domestic product”); all the major balancing items in the accounts from value added through to saving may be recorded gross or net.

Government final consumption expenditure

Government final consumption expenditure consists of expenditure, including imputed expenditure, incurred by general government on both individual consumption goods and services and collective consumption services.

Gross capital formation

Gross capital formation is measured by the total value of the gross fixed capital formation, changes in inventories and acquisitions less disposals of valuables for a unit or sector.

Gross capital stock

Gross capital stock is the value of all fixed assets still in use, at the actual or estimated current purchasers’ prices for new assets of the same type, irrespective of the age of the assets.

Gross domestic product - expenditure based

Expenditure-based gross domestic product is total final expenditures at purchasers’ prices (including the FOB value of exports of goods and services), less the FOB value of imports of goods and services.

Gross domestic product - income based

Income-based gross domestic product is compensation of employees, plus taxes less subsidies on production and imports, plus gross mixed income, plus gross operating surplus.

Gross domestic product - output based

Output-based gross domestic product is the sum of the gross values added of all resident producers at basic prices, plus all taxes less subsidies on products.

Gross fixed capital formation

Gross fixed capital formation is measured by the total value of a producer’s acquisitions, less disposals, of fixed assets during the accounting period plus certain additions to the value of non-produced assets (such as subsoil assets or major improvements in the quantity, quality or productivity of land) realised by the productive activity of institutional units.

Gross national disposable income

Gross national disposable income may be derived from gross national income by adding all current transfers in cash or in kind receivable by resident institutional units from non-resident units and subtracting all current transfers in cash or in kind payable by resident institutional units to non-resident units.

Gross national income (GNI)

Gross national income (GNI) is GDP less net taxes on production and imports, less compensation of employees and property income payable to the rest of the world plus the corresponding items receivable from the rest of the world (in other words, GDP less primary incomes payable to non-resident units plus primary incomes receivable from non-resident units); an alternative approach to measuring GNI at market prices is as the aggregate value of the balances of gross primary incomes for all sectors; (note that gross national income is identical to gross national product (GNP) as previously used in national accounts generally).

Gross national product (GNP)

Gross national product (GNP): see “Gross national income”.

Gross saving

Gross saving is gross disposable income less final consumption expenditure.

Gross value added

Gross value added is the value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry or sector; gross value added is the source from which the primary incomes of the SNA are generated and is therefore carried forward into the primary distribution of income account.

Gross value added at basic prices

Gross value added at basic prices is output valued at basic prices less intermediate consumption valued at purchasers’ prices.

Gross value added at producers’ prices

Gross value added at producers’ prices is output valued at producers’ prices less intermediate consumption valued at purchasers’ prices.

Hedonic method

The hedonic method is a regression technique used to estimate the prices of qualities or models that are not available on the market in particular periods, but whose prices in those periods are needed in order to be able to construct price relatives; it is based on the hypothesis that the prices of different models on sale on the market at the same time are functions of certain measurable characteristics such as size, weight, power, speed, etc and so regression methods can be used to estimate by how much the price varies in relation to each of the characteristics.

Homogeneous production unit

A unit of homogeneous production is a producer unit in which only a single (non-ancillary) productive activity is carried out; this unit is not normally observable and is more an abstract or conceptual unit underlying the symmetric (product-by-product) input-output tables.

Horizontally integrated enterprise

A horizontally integrated enterprise is one in which several different kinds of activities which produce different kinds of goods or services for sale on the market are carried out in parallel with each other.

Hours worked – total

Total hours worked are the aggregate number of hours actually worked during the period in employee and self-employment jobs.

Household

A household is a small group of persons who share the same living accommodation, who pool some, or all, of their income and wealth and who consume certain types of goods and services collectively, mainly housing and food.

Household actual final consumption

Actual final consumption of households is the value of the consumption goods and services acquired by households, whether by purchase in general, or by transfer from government units or NPISHs, and used by them for the satisfaction of their needs and wants; it is derived from their final consumption expenditure by adding the value of social transfers in kind receivable.

Household final consumption expenditure

Household final consumption expenditure consists of the expenditure, including imputed expenditure, incurred by resident households on individual consumption goods and services, including those sold at prices that are not economically significant.

Household unincorporated market enterprises

Household unincorporated market enterprises are created for the purpose of producing goods or services for sale or barter on the market; they can be engaged in virtually any kind of productive activity and they include unincorporated partnerships but the liability of the partners for the debts of the businesses must be unlimited for the partnerships to be treated as unincorporated enterprises.

Import duties

Import duties consist of customs duties, or other import charges, which are payable on goods of a particular type when they enter the economic territory.

Import subsidies

Import subsidies consist of subsidies on goods and services that become payable to resident producers when the goods cross the frontier of the economic territory or when the services are delivered to resident institutional units.

Imports of goods

Imports of goods consist of imports of the following items from non-residents to residents, generally with a change of ownership being involved: general merchandise, goods for processing, goods procured in foreign ports by domestic carriers, and non-monetary gold.

Imports of services

Imports of services consist of the following services purchased by residents from non-residents: transportation; travel; communications; construction; insurance; financial; computer and information; royalties and licence fees; other business services; personal, cultural, and recreational services; and government services n.i.e.

Imports of goods and services

Imports of goods and services consist of purchases, barter, or receipts of gifts or grants, of goods and services by residents from non-residents; the treatment of exports and imports in the SNA is generally identical with that in the balance of payments accounts as described in the Balance of Payments Manual.

Imputed expenditure

Some transactions which it is desirable to include in the accounts do not take place in money terms and so cannot be measured directly; in such cases a conventional value is imputed to the corresponding expenditure (the conventions used vary from case to case and are described in the SNA as necessary).

Imputed social contributions

Social contributions are imputed when employers provide social benefits themselves directly to their employees, former employees or dependants out of their own resources without involving an insurance enterprise or autonomous pension fund, and without creating a special fund or segregated reserve for the purpose; the imputed contributions are equal in value to the amount of social contributions that would be needed to secure the de facto entitlements to the social benefits they accumulate.

Income

Income is the maximum amount that a household, or other unit, can consume without reducing its real net worth provided the net worth at the beginning of the period is not changed by capital transfers, other changes in the volume of assets or real holding gains or losses.

Income from abroad – net

Net income from abroad is the difference between the total values of the primary incomes receivable from, and payable to, non-residents.

Income in kind received by employees

Income in kind received by employees is measured by the value of the goods and services provided by employers to their employees in remuneration for work done.

Incorporated enterprise

Incorporated enterprise: see “Corporation”.

Indirect taxes

As traditionally understood, indirect taxes are taxes that supposedly can be passed on, in whole or in part, to other institutional units by increasing the prices of the goods or services sold; however the term “indirect taxes” is not used in SNA93; rather, taxes are specifically identified by their purpose (e.g. taxes on products).

Individual consumption good or service

An individual consumption good or service is one that is acquired by a household and used to satisfy the needs and wants of members of that household.

Industry

An industry consists of a group of establishments engaged on the same, or similar, kinds of production activity; the classification of productive activities used in the SNA is ISIC (Rev.3).

Industry (producer) technology

Industry (producer) technology is one of two types of technology assumptions used in converting supply and use tables into symmetric input-output tables; it assumes that all products produced by an industry are produced with the same input structure.

Industry-by-industry table

An industry-by-industry (input-output) table shows which industry uses the output of which other industry.

Input-output table

An input-output table is a means of presenting a detailed analysis of the process of production and the use of goods and services (products) and the income generated in that production.; they can be either in the form of (a) supply and use tables or (b) symmetric input-output tables.

Institutional sectors

Institutional units are grouped together to form institutional sectors, on the basis of their principal functions, behaviour, and objectives.

Institutional unit

An institutional unit is an economic entity that is capable, in its own right, of owning assets, incurring liabilities and engaging in economic activities and in transactions with other entities.

Intangible fixed assets

Intangible fixed assets are non-financial produced fixed assets that mainly consist of mineral exploration, computer software, entertainment, literary or artistic originals intended to be used for more than one year.

Integrated economic accounts

The integrated economic accounts comprise the full set of accounts of institutional sectors and the rest of the world, together with the accounts for transactions (and other flows) and the accounts for assets and liabilities.

Intermediate consumption

Intermediate consumption consists of the value of the goods and services consumed as inputs by a process of production, excluding fixed assets whose consumption is recorded as consumption of fixed capital; the goods or services may be either transformed or used up by the production process.

Intermediate use quadrant

The intermediate use quadrant (of the use table) shows intermediate consumption at purchasers' prices by industries in the columns and by products in the rows.

Internal transactions

The SNA treats as transactions certain kinds of actions within a unit to give a more analytically useful picture of final uses of output and of production; these transactions that involve only one unit are called internal, or intra-unit, transactions.

Intra-unit transactions

The SNA treats as transactions certain kinds of actions within a unit to give a more analytically useful picture of final uses of output and of production; these transactions that involve only one unit are called internal, or intra-unit, transactions.

Inventories

Inventories consist of stocks of outputs that are still held by the units that produced them prior to their being further processed, sold, delivered to other units or used in other ways and stocks of products acquired from other units that are intended to be used for intermediate consumption or for resale without further processing.

Inventories - changes in (including work-in-progress)

Changes in inventories (including work-in-progress) consist of changes in : (a) stocks of outputs that are still held by the units that produced them prior to their being further processed, sold, delivered to other units or used in other ways; and (b) stocks of products acquired from other units that are intended to be used for intermediate consumption or for resale without further processing; they are measured by the value of the entries into inventories less the value of withdrawals and the value of any recurrent losses of goods held in inventories.

Inventories of finished goods

Inventories of finished goods consist of goods that are ready for sale or shipment by the producer but which are still held by the producer.

Inventories of goods for resale

Inventories of goods for resale consist of goods acquired by enterprises, such as wholesalers and retailers, for the purpose of reselling them without further processing (that is, not transformed other than by presenting them in ways that are attractive to the customer).

Inventories of materials and supplies

Inventories of materials and supplies are goods that their owners intend to use as intermediate inputs in their own production processes, not to resell.

Inventories of other work-in-progress

Inventories of other work-in-progress consist of goods other than cultivated assets and services that have been partially processed, fabricated or assembled by the producer but that are not usually sold, shipped or turned over to others without further processing.

Inventories of work-in progress

Inventories of work-in progress consist of goods and services that are partially completed but that are not usually turned over to other units without further processing or that are not mature and whose production process will be continued in a subsequent period by the same producer.

Inverse table – Leontief

The columns of the Leontief inverse (input-output) table show the input requirements, both direct and indirect, on all other producers, generated by one unit of output.

Investment grants

Investment grants consist of capital transfers in cash or in kind made by governments to other resident or non-resident institutional units to finance all or part of the costs of their acquiring fixed assets.

Invoiced VAT

Invoiced VAT (value added tax) is the VAT payable on the sales of a producer; it is shown separately on the invoice which the producer presents to the purchaser.

ISIC

ISIC is the United Nations International Standard Industrial Classification of All Economic Activities; the third revision of ISIC is used in the 1993 SNA.

Joint products

When two or more products are produced simultaneously by a single productive activity they are joint products.

Kind-of-activity unit (KAU)

A kind-of-activity unit (KAU) is an enterprise, or a part of an enterprise, which engages in only one kind of (non-ancillary) productive activity or in which the principal productive activity accounts for most of the value added.

Land

Land is the ground, including the soil covering and any associated surface waters, over which ownership rights are enforced; included are major improvements that cannot be physically separated from the land itself but it excludes any buildings or other structures situated on it or running through it; cultivated crops, trees and animals; subsoil assets; non-cultivated biological resources and water resources below the ground.

Laspeyres price index

A Laspeyres price index is a weighted arithmetic average of price relatives using the values of the earlier period as weights.

Laspeyres volume index

A Laspeyres volume index is a weighted arithmetic average of quantity relatives using the values of the earlier period as weights.

Leases and other transferable contracts

Leases and other transferable contracts are leases or contracts where the lessee has the right to convey the lease to a third party independently of the lessor (e.g. leases of land and buildings and other structures, concessions or exclusive rights to exploit mineral deposits or fishing grounds, transferable contracts with athletes and authors and options to buy tangible assets not yet produced).

Legal entities

Legal entities are types of institutional units which are created for purposes of production, mainly corporations and non-profit institutions (NPIs), or government units, including social security funds; they are capable of owning goods and assets, incurring liabilities and engaging in economic activities and transactions with other units in their own right.

Leontief inverse table

The columns of the Leontief inverse (input-output) table show the input requirements, both direct and indirect, on all other producers, generated by one unit of output.

Local government

Local government units are institutional units whose fiscal, legislative and executive authority extends over the smallest geographical areas distinguished for administrative and political purposes.

Local unit

A local unit is an enterprise, or a part of an enterprise, which engages in productive activity at or from one location.

Machinery and equipment (assets)

Machinery and equipment consists of transport equipment (assets) and other machinery and equipment other than that acquired by households for final consumption.

Maintenance and repairs (of fixed assets)

Ordinary maintenance and repairs of fixed assets are activities that owners or users of fixed assets are obliged to undertake periodically in order to be able to utilise assets over their expected service lives (they are current costs that cannot be avoided if the fixed assets are to continue to be used); maintenance and repairs do not change the fixed asset or its performance, but simply maintain it in good working order or restore it to its previous condition in the event of a breakdown (note the contrast between this item and “major renovations or enlargements”).

Major renovations or enlargements (of fixed assets)

Major renovations or enlargements of fixed assets are activities which increase the performance or capacity of existing fixed assets or significantly extend their previously expected service lives and so are classified as part of gross fixed capital formation; the decision to renovate, reconstruct or enlarge a fixed asset is a deliberate investment decision which may be undertaken at any time and is not dictated by the condition of the asset (note the contrast between this item and “maintenance and repairs”).

Margin (trade)

A trade margin is the difference between the actual or imputed price realised on a good purchased for resale (either wholesale or retail) and the price that would have to be paid by the distributor to replace the good at the time it is sold or otherwise disposed of.

Margin (transport)

A transport margin consists of those transport charges paid separately by the purchaser in taking delivery of the goods at the required time and place.

Margins (financial)

Margins are payments of cash or collateral that cover actual or potential obligations under financial derivatives, especially futures or exchange-traded options.

Market establishments

Market establishments produce mostly goods and services for sale at prices which are economically significant.

Market non-profit institutions serving businesses

Market non-profit institutions serving businesses are created by associations of the businesses whose interests they are designed to promote and usually financed by contributions or subscriptions from the group of businesses concerned; the subscriptions are treated not as transfers but as payments for services rendered.

Market output

Market output is output that is sold at prices that are economically significant or otherwise disposed of on the market or intended for sale or disposal on the market.

Market price equivalents

Market price equivalents are proxies, or substitute measures, for market prices in those cases for which no actual market prices have been set; a customary approach is to construct such prices by analogy with known market prices established under conditions that are considered essentially the same.

Market prices

Market prices for transactions are the amounts of money willing buyers pay to acquire something from willing sellers.

Market producers

Market producers are producers that sell most or all of their output at prices that are economically significant.

Materials and supplies – inventories

Inventories of materials and supplies are goods that their owners intend to use as intermediate inputs in their own production processes, not to resell.

Miscellaneous current taxes

Miscellaneous current taxes consist of various types of taxes paid periodically, usually once a year; the most common are poll taxes, expenditure taxes, payments by households to obtain certain licences, and taxes on international transactions.

Miscellaneous current transfers

Miscellaneous current transfers consist of various different kinds of current transfers that may take place between resident institutional units or between resident and non-resident units; the most common are: (a) current transfers to NPISHs; (b) current transfers between households; (c) fines and penalties; (d) lotteries and gambling; (e) payments of compensation.

Mixed income

Mixed income is the surplus or deficit accruing from production by unincorporated enterprises owned by households; it implicitly contains an element of remuneration for work done by the owner, or other members of the household, that cannot be separately identified from the return to the owner as entrepreneur but it excludes the operating surplus coming from owner-occupied dwellings.

Monetary transactions

A monetary transaction is one in which one institutional unit makes a payment (receives a payment) or incurs a liability (receives an asset) stated in units of currency.

NACE (Statistical Classification of Economic Activities in the European Community)

NACE Rev. 2 is the classification of economic activities corresponding to ISIC Rev. 4 at European level. Though more disaggregated than ISIC Rev. 4, NACE Rev. 2 is completely in line with it and can thus be regarded as its European version.

National disposable income

National disposable income may be derived from national income by adding all current transfers in cash or in kind receivable by resident institutional units from non-resident units and subtracting all current transfers in cash or in kind payable by resident institutional units to non-resident units.

National expenditure

Capital formation and final consumption grouped together constitute national expenditure.

National income

National income is the total value of the primary incomes receivable within an economy less the total of the primary incomes payable by resident units.

National private corporations (non-financial and financial)

National private corporations include all resident corporations and quasi-corporations that are not controlled by government or by non-resident institutional units.

National wealth

National wealth is the sum, for the economy as a whole, of non-financial assets and net claims on the rest of the world.

NDP (net domestic product)

NDP (net domestic product) is obtained by deducting the consumption of fixed capital from gross domestic product.

Net

The term "net" is a common means of referring to values after deducting consumption of fixed capital (generally used as in "net capital stock" or "net domestic product"); all the major balancing items in the accounts from value added through to saving may be recorded gross or net; it should be noted, however, that the term "net" can be used in different contexts in the national accounts, such as "net income from abroad" which is the difference between two income flows.

Net adjusted disposable income

Net adjusted disposable income is obtained from the net disposable income of an institutional unit or sector by adding the value of the social transfers in kind receivable by that unit or sector and subtracting the value of the social transfers in kind payable by that unit or sector.

Net borrowing

Net borrowing: See "net lending".

Net capital stock

The sum of the written-down values of all the fixed assets still in use is described as the net capital stock; it can also be described as the difference between gross capital stock and consumption of fixed capital.

Net domestic product (NDP)

Net domestic product (NDP) is obtained by deducting the consumption of fixed capital from gross domestic product.

Net fixed capital formation

Net fixed capital formation consists of gross fixed capital formation less consumption of fixed capital.

Net income from abroad

Net income from abroad is the difference between the total values of the primary incomes receivable from, and payable to, non-residents.

Net national disposable income

Net national disposable income may be derived from net national income by adding all current transfers in cash or in kind receivable by resident institutional units from non-resident units and subtracting all current transfers in cash or in kind payable by resident institutional units to non-resident units.

Net national income

The aggregate value of the balances of net primary incomes summed over all sectors is described as net national income.

Net saving

Net saving is net disposable income less final consumption expenditure.

Net value added

Net value added is the value of output less the values of both intermediate consumption and consumption of fixed capital.

Nominal interest

When a debtor is able to discharge his liability to the creditor by repaying principal equal in money value to the funds borrowed, the associated interest payments are described as "nominal".

Non-deductible VAT

Non-deductible value added tax is the VAT payable by a purchaser which is not deductible from his own VAT liability, if any.

Non-durable good

A non-durable good is one which is used up entirely in less than a year, assuming a normal or average rate of physical usage.

Non-financial assets

Non-financial assets are entities, over which ownership rights are enforced by institutional units, individually or collectively, and from which economic benefits may be derived by their owners by holding them, or using them over a period of time, that consist of tangible assets, both produced and non-produced, and most intangible assets for which no corresponding liabilities are recorded.

Non-financial corporations

Non-financial corporations are corporations whose principal activity is the production of market goods or non-financial services.

Non-financial quasi-corporations

Non-financial quasi-corporations are quasi-corporations whose principal activity is the production of market goods or non-financial services.

Non-market output – other

Other non-market output consists of goods and individual or collective services produced by non-profit institutions serving households (NPISHs) or government that are supplied free, or at prices that are not economically significant, to other institutional units or the community as a whole; such output is one of three broad categories of output in the SNA, with the others being market output and output produced for own final use.

Non-market producers

Non-market producers are producers that provide most of their output to others free or at prices which are not economically significant.

Non-monetary transactions

Non-monetary transactions are transactions that are not initially stated in units of currency; barter is an obvious example.

Non-produced assets

Non-produced assets are non-financial assets that come into existence other than through processes of production; they include both tangible assets and intangible assets and also include costs of ownership transfer on and major improvements to these assets.

Non-profit institutions (NPIs)

Non-profit institutions (NPIs) are legal or social entities created for the purpose of producing goods and services whose status does not permit them to be a source of income, profit or other financial gain for the units that establish, control or finance them.

Non-profit institutions controlled and mainly financed by government

Non-profit institutions controlled and mainly financed by government are properly constituted legal entities which exist separately from government but which are financed mainly by government and over which government exercises control.

Non-profit institutions engaged in market production

Non-profit institutions engaged in market production consist of those NPIs which charge fees determined by their costs of production and which are sufficiently high to have a significant influence on the demand for their services, but any surpluses such institutions make must be retained within those institutions as their status as "Non-profit institutions (NPIs)" prevents them from distributing them to others.

Non-profit institutions engaged in non-market production

Non-profit institutions engaged in non-market production are NPIs that are incapable of providing financial gain to the units which control or manage them, and which must rely principally on funds other than receipts from sales to cover their costs of production or other activities.

Non-profit institutions serving households (NPISHs)

Non-profit institutions serving households (NPISHs) consist of NPIs which are not predominantly financed and controlled by government and which provide goods or services to households free or at prices that are not economically significant.

Non-repayable margins

Non-repayable margins reduce a financial liability created under a financial derivative contract. The entity that pays a non-repayable margin no longer retains ownership of the margin nor has the right to the risks and rewards of ownership such as the receipt of income or exposure to holding gains and losses.

Non-resident

A unit is non-resident if its centre of economic interest is not in the economic territory of a country.

Non-residential buildings

Non-residential buildings are buildings other than dwellings, including fixtures, facilities and equipment that are integral parts of the structures and costs of site clearance and preparation.

NPIs (non-profit institutions)

NPIs (non-profit institutions) are legal or social entities created for the purpose of producing goods and services whose status does not permit them to be a source of income, profit or other financial gain for the units that establish, control or finance them.

NPISHs (non-profit institutions serving households)

NPISHs (non-profit institutions serving households) consist of NPIs which are not predominantly financed and controlled by government and which provide goods or services to households free or at prices that are not economically significant.

NPISH final consumption expenditure

Final consumption expenditure of NPISHs consists of the expenditure, including imputed expenditure, incurred by resident NPISHs on individual consumption goods and services.

Occupied persons

In order to be classified as occupied - i.e. either employed or self-employed - the person must be engaged in an activity that falls within the production boundary of the SNA.

Operating surplus

The operating surplus measures the surplus or deficit accruing from production before taking account of any interest, rent or similar charges payable on financial or tangible non-produced assets borrowed or rented by the enterprise, or any interest, rent or similar receipts receivable on financial or tangible non-produced assets owned by the enterprise; (note: for unincorporated enterprises owned by households, this component is called “mixed income”).

Opportunity cost

The concept of opportunity cost is commonly used in economics; it is measured by reference to the opportunities foregone at the time an asset or resource is used, as distinct from the costs incurred at some time in the past to acquire the asset, or the payments which could be realised by an alternative use of a resource (e.g. the use of labour in a voluntary capacity being valued at the wages which could have been earned in a paid job).

Other current taxes

Other current taxes consist of current taxes on capital plus miscellaneous current taxes.

Other current transfers

Other current transfers consist of net premiums and claims for non-life insurance, current transfers between different kinds of government units, usually at different levels of government and also between general government and foreign governments, and current transfers such as those between different households.

Other non-market establishments

Other non-market establishments supply most of the goods and services they produce without charge or at prices which are not economically significant; they are one of three broad types of producer, with the others being market producers and producers for own final use.

Other non-market output

Other non-market output consists of goods and individual or collective services produced by non-profit institutions serving households (NPISHs) or government that are supplied free, or at prices that are not economically significant, to other institutional units or the community as a whole; such output is one of three broad categories of output in the SNA, with the others being market output and output produced for own final use.

Other non-market producers

Other non-market producers consist of establishments owned by government units or NPISHs that supply goods or services free, or at prices that are not economically significant, to households or the community as a whole; these producers may also have some sales of secondary market output whose prices are intended to cover their costs or earn a surplus.

Other subsidies on production

Other subsidies on production consist of subsidies, except subsidies on products, which resident enterprises may receive as a consequence of engaging in production (e.g. subsidies on payroll or workforce or subsidies to reduce pollution).

Other subsidies on products

Other subsidies on products (other than export or import subsidies) consist of subsidies on goods or services produced as the outputs of resident enterprises that become payable as a result of the production, sale, transfer, leasing or delivery of those goods or services, or as a result of their use for own consumption or own capital formation; there are three broad categories: (a) subsidies on products used domestically, (b) losses of government trading organisations, and (c) subsidies to public corporations and quasi-corporations.

Other taxes on income n.e.c.

Other taxes on income not elsewhere classified consist of any income taxes other than taxes on individual or household income, taxes on the income of corporations, taxes on capital gains, and taxes on winnings from lotteries or gambling.

Other taxes on production

Other taxes on production consist of taxes other than those incurred directly as a result of engaging in production; they mainly consist of current taxes on the labour or capital employed in the enterprise, such as payroll taxes or current taxes on vehicles or buildings.

Other valuables

The other valuables category of non-financial, tangible, non-produced fixed assets consists of valuables not elsewhere classified, such as collections and jewellery of significant value fashioned out of precious stones and metals.

Other work-in-progress – inventories

Inventories of other work-in-progress consist of goods other than cultivated assets and services that have been partially processed, fabricated or assembled by the producer but that are not usually sold, shipped or turned over to others without further processing.

Output

Output consists of those goods or services that are produced within an establishment that become available for use outside that establishment, plus any goods and services produced for own final use.

Output produced for own final use

Output produced for own final use consists of goods or services that are retained for their own final use by the owners of the enterprises in which they are produced.

Own-account producers

Own-account producers consist of establishments engaged in gross fixed capital formation for the enterprises of which they form part or unincorporated enterprises owned by households all or most of whose output is intended for final consumption or gross fixed capital formation by those households.

Own-account workers

Own-account workers are self-employed persons without paid employees.

Paasche price index

A Paasche price index is the harmonic average of price relatives using the values of the later period as weights.

Paasche volume index

A Paasche volume index is the harmonic average of volume relatives using the values of the later period as weights.

Perpetual inventory method (PIM)

The perpetual inventory method (PIM) is a method of constructing estimates of capital stock and consumption of fixed capital from time series of gross fixed capital formation; it allows an estimate to be made of the stock of fixed assets in existence and in the hands of producers which is generally based on estimating how many of the fixed assets installed as a result of gross fixed capital formation undertaken in previous years have survived to the current period; a PIM approach is also commonly used in valuing changes in inventories.

PPP (purchasing power parity)

A PPP (purchasing power parity) is a price relative which measures the number of units of country B's currency that are needed in country B to purchase the same quantity of an individual good or service as 1 unit of country A's currency will purchase in country A.

Price

The price of a good or service is the value of one unit of that good or service.

Price index

A price index reflects an average of the proportionate changes in the prices of a specified set of goods and services between two periods of time.

Price relative

A price relative is the ratio of the price of a specific product in one period to the price of the same product in some other period; in PPP comparisons a price relative refers to the ratios of the same product in two countries.

Primary incomes

Primary incomes are incomes that accrue to institutional units as a consequence of their involvement in processes of production or ownership of assets that may be needed for purposes of production.

Principal activity

The principal activity of a producer unit is the activity whose value added exceeds that of any other activity carried out within the same unit (the output of the principal activity must consist of goods or services that are capable of being delivered to other units even though they may be used for own consumption or own capital formation).

Private corporations (non-financial and financial)

Private corporations are all resident corporations and quasi-corporations that are not controlled by government.

Produced assets

Produced assets are non-financial assets that have come into existence as outputs from processes that fall within the production boundary of the SNA; produced assets consist of fixed assets, inventories and valuables.

Producers for own final use

Producers for own final use produce mostly goods and services for final consumption or fixed capital formation by the owners of the enterprises in which they are produced.

Producer's price

A producer's price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any VAT, or similar deductible tax, invoiced to the purchaser; it excludes any transport charges invoiced separately by the producer.

Product (commodity) technology

Product (commodity) technology is one of two types of technology assumptions used in converting supply and use tables into symmetric input-output tables; it assumes that a product has the same input structure in whichever industry it is produced.

Product-by-product table

A product-by-product table is a symmetric input-output table with products as the dimension of both rows and columns; as a result it shows which products are used in the production of which other products.

Production

Production is an activity, carried out under the responsibility, control and management of an institutional unit that uses inputs of labour, capital and goods and services to produce outputs of goods and services.

Production account

The production account records the activity of producing goods and services as defined within the SNA; its balancing item, gross value added, is a measure of the contribution to GDP made by an individual producer, industry or sector.

Production boundary

The production boundary includes (a) the production of all individual or collective goods or services that are supplied to units other than their producers, or intended to be so supplied, including the production of goods or services used up in the process of producing such goods or services; (b) the own-account production of all goods that are retained by their producers for their own final consumption or gross capital formation; (c) the own-account production of housing services by owner-occupiers and of domestic and personal services produced by employing paid domestic staff.

Products

Products, also called “goods and services”, are the result of production; they are exchanged and used for various purposes: as inputs in the production of other goods and services, as final consumption or for investment.

Property income

Property income is the income receivable by the owner of a financial asset or a tangible non-produced asset in return for providing funds to or putting the tangible non-produced asset at the disposal of, another institutional unit; it consists of interest, the distributed income of corporations (i.e. dividends and withdrawals from income of quasi-corporations), reinvested earnings on direct foreign investment, property income attributed to insurance policy holders, and rent.

Public corporations (non-financial and financial)

Public corporations are resident corporations and quasi-corporations that are subject to control by government units, with control over a corporation being defined as the ability to determine general corporate policy by choosing appropriate directors, if necessary.

Purchaser’s price

The purchaser’s price is the amount paid by the purchaser, excluding any deductible VAT or similar deductible tax, in order to take delivery of a unit of a good or service at the time and place required by the purchaser; the purchaser’s price of a good includes any transport charges paid separately by the purchaser to take delivery at the required time and place.

Purchasing power parity (PPP)

A purchasing power parity (PPP) is a price relative which measures the number of units of country B’s currency that are needed in country B to purchase the same quantity of an individual good or service as 1 unit of country A’s currency will purchase in country A.

Quantity index

A quantity index is built up from information on quantities such as the number or total weight of goods or the number of services; the quantity index has no meaning from an economic point of view if it involves adding quantities that are not commensurate, although it is often used as a proxy for a volume index.

Quantity relative

A quantity relative is the ratio of the quantity of a specific product in one period to the quantity of the same product in some other period.

Quasi-corporations

Quasi-corporations are unincorporated enterprises that function as if they were corporations, and which have complete sets of accounts, including balance sheets.

Real gross domestic income (real GDI)

Real gross domestic income (real GDI) measures the purchasing power of the total incomes generated by domestic production (including the impact on those incomes of changes in the terms of trade); it is equal to gross domestic product at constant prices plus the trading gain (or less the trading loss) resulting from changes in the terms of trade.

Real income

Real income is obtained by deflating any income flow by a price index in order to measure the purchasing power of the item in question over a designated numeraire set of goods and services.

Real interest

Real interest is the difference between nominal interest and an amount equal to the loss of purchasing power on the monetary value of the principal during the accounting period.

Reference period

In connection with price or volume indices, the reference period means the period to which the indices relate; it is typically set equal to 100 and it does not necessarily coincide with the "base" period that provides the weights for the indices.

Replacement cost accounting

Replacement cost accounting See "Current cost accounting".

Rest of the world

The rest of the world consists of all non-resident institutional units that enter into transactions with resident units, or have other economic links with resident units.

Rest of the world account

The rest of the world account comprises those categories of accounts necessary to capture the full range of transactions that take place between the total economy and the rest of the world (i.e. between residents and non-residents).

Royalties

"Royalties" is the term often used to describe either the regular payments made by the lessees of subsoil assets to the owners of the assets (these payments are treated as rents in the SNA) or the payments made by units using processes or producing products covered by patents (these are treated as purchases of services produced by the owners of the patents in the SNA).

SAM (social accounting matrix)

A SAM (social accounting matrix) is a means of presenting the SNA accounts in a matrix which elaborates the linkages between a supply and use table and institutional sector accounts; a typical focus of a SAM on the role of people in the economy may be reflected by, among other things, extra breakdowns of the household sector and a disaggregated representation of labour markets (i.e., distinguishing various categories of employed persons).

Satellite accounts

Satellite accounts provide a framework linked to the central accounts and which enables attention to be focussed on a certain field or aspect of economic and social life in the context of national accounts; common examples are satellite accounts for the environment, or tourism, or unpaid household work.

Saving

Saving is disposable income less final consumption expenditure (or adjusted disposable income less actual final consumption), in both cases after taking account of an adjustment for pension funds; saving is an important aggregate which can be calculated for each institutional sector or for the whole economy.

Secondary activity

A secondary activity is an activity carried out within a single producer unit in addition to the principal activity and whose output, like that of the principal activity, must be suitable for delivery outside the producer unit.

Sectors (or "institutional sectors")

Institutional units are grouped together to form institutional sectors, on the basis of their principal functions, behaviour, and objectives.

Self-employed workers

Self-employed workers are persons who are the sole owners, or joint owners, of the unincorporated enterprises in which they work, excluding those unincorporated enterprises that are classified as quasi-corporations.

Services

Services are outputs produced to order and which cannot be traded separately from their production; ownership rights cannot be established over services and by the time their production is completed they must have been provided to the consumers; however as an exception to this rule there is a group of industries, generally classified as service industries, some of whose outputs have characteristics of goods, i.e. those concerned with the provision, storage, communication and dissemination of information, advice and entertainment in the broadest sense of those terms; the products of these industries, where ownership rights can be established, may be classified either as goods or services depending on the medium by which these outputs are supplied.

Single indicator method of deflation

A single indicator method of deflation is a means of estimating the volume movements of value added directly using only one time series as an indicator (e.g. deflated output or deflated value added) instead of double deflation.

SNA (System of National Accounts)

The System of National Accounts (SNA) consists of a coherent, consistent and integrated set of macroeconomic accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules.

Social accounting matrix (SAM)

A social accounting matrix (SAM) is a means of presenting the SNA accounts in a matrix which elaborates the linkages between a supply and use table and institutional sector accounts; a typical focus of a SAM on the role of people in the economy may be reflected by, among other things, extra breakdowns of the household sector and a disaggregated representation of labour markets (i.e., distinguishing various categories of employed persons).

Social assistance benefits

Social assistance benefits are transfers made by government units or NPIs to households intended to meet the same kinds of needs as social insurance benefits but are provided outside of an organised social insurance scheme and not conditional on previous payments of contributions.

Social assistance benefits in kind

Social assistance benefits in kind consist of transfers in kind provided to households by government units or NPISHs that are similar in nature to social security benefits in kind but are not provided in the context of a social insurance scheme.

Social benefits

Social benefits are current transfers received by households intended to provide for the needs that arise from certain events or circumstances, for example, sickness, unemployment, retirement, housing, education or family circumstances.

Social benefits in kind

Social benefits in kind consist of (a) social security benefits, reimbursements, (b) other social security benefits in kind, (c) social assistance benefits in kind; in other words they are equal to social transfers in kind excluding transfers of individual non-market goods and services.

Social contributions

Social contributions are actual or imputed payments to social insurance schemes to make provision for social insurance benefits to be paid.

Social contributions by self-employed and non-employed persons

Social contributions by self-employed and non-employed persons are social contributions payable for their own benefit by persons who are not employees - i.e. self-employed persons (employers or own-account workers), or non-employed persons.

Social insurance benefits

Social insurance benefits are transfers provided under organised social insurance schemes; social insurance benefits may be provided under general social security schemes, under private funded social insurance schemes or by unfunded schemes managed by employers for the benefit of their existing or former employees without involving third parties in the form of insurance enterprises or pension funds.

Social transfers in kind

Social transfers in kind consist of individual goods and services provided as transfers in kind to individual households by government units (including social security funds) and NPISHs, whether purchased on the market or produced as non-market output by government units or NPISHs; the items included are: (a) social security benefits, reimbursements, (b) other social security benefits in kind, (c) social assistance benefits in kind, and (d) transfers of individual non-market goods or services.

Subsidiary corporation

Corporation B is said to be a subsidiary of corporation A when either (a) corporation A controls more than half of the shareholders' voting power in corporation B; or (b) corporation A is a shareholder in corporation B with the right to appoint or remove a majority of the directors of corporation B.

Subsidies

Subsidies are current unrequited payments that government units, including non-resident government units, make to enterprises on the basis of the levels of their production activities or the quantities or values of the goods or services which they produce, sell or import.

Subsidies on production – other

Other subsidies on production consist of subsidies, except subsidies on products, which resident enterprises may receive as a consequence of engaging in production (e.g. subsidies on payroll or workforce or subsidies to reduce pollution).

Subsidies on products – other

Other subsidies on products (other than export or import subsidies) consist of subsidies on goods or services produced as the outputs of resident enterprises that become payable as a result of the production, sale, transfer, leasing or delivery of those goods or services, or as a result of their use for own consumption or own capital formation; there are three broad categories: (a) subsidies on products used domestically, (b) losses of government trading organisations, and (c) subsidies to public corporations and quasi-corporations.

Supply and use tables

Supply and use tables are in the form of matrices that record how supplies of different kinds of goods and services originate from domestic industries and imports and how those supplies are allocated between various intermediate or final uses, including exports.

Symmetric tables

Symmetric (input-output) tables are tables in which the same classifications or units (i.e. the same groups of products or industries) are used in both rows and columns.

System of National Accounts (SNA)

The System of National Accounts (SNA) consists of a coherent, consistent and integrated set of macroeconomic accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules.

Tangible fixed assets

Tangible fixed assets are non-financial produced assets that consist of dwellings; other buildings and structures; machinery and equipment and cultivated assets.

Tangible non-produced assets

Tangible non-produced assets are natural assets - land, subsoil assets, non-cultivated biological resources and water resources - over which ownership may be established and transferred.

Tax on a product

A tax on a product is a tax that is payable per unit of some good or service, either as a specified amount of money per unit of quantity or as a specified percentage of the price per unit or value of the good or service transacted.

Taxes

Taxes are compulsory, unrequited payments, in cash or in kind, made by institutional units to government units; they are described as unrequited because the government provides nothing in return to the individual unit making the payment, although governments may use the funds raised in taxes to provide goods or services to other units, either individually or collectively, or to the community as a whole.

Taxes (recurrent) on land, buildings or other structures

Taxes (recurrent) on land, buildings or other structures consist of taxes payable regularly, usually each year, in respect of the use or ownership of land, buildings or other structures utilised by enterprises in production, whether the enterprises own or rent such assets.

Taxes and duties on imports

Taxes and duties on imports, excluding VAT, consist of taxes on goods and services that become payable at the moment when the goods cross the national or customs frontiers of the economic territory or when the services are delivered by non-resident producers to resident institutional units.

Taxes on capital gains

Taxes on capital gains consist of taxes on the holding gains of persons or corporations which become due for payment during the current accounting period, irrespective of the periods over which the gains have accrued.

Taxes on capital transfers

Taxes on capital transfers consist of taxes on the values of assets transferred between institutional units.

Taxes on entertainment

Taxes on entertainment consist of any taxes which are levied specifically on the entertainment itself (such as on an entry ticket) and which are not part of some broader tax such as a VAT.

Taxes on financial and capital transactions

Taxes on financial and capital transactions consist of taxes payable on the purchase or sale of non-financial and financial assets including foreign exchange.

Taxes on income

Taxes on income consist of taxes on incomes, profits and capital gains; they are assessed on the actual or presumed incomes of individuals, households, NPIs or corporations.

Taxes on individual or household income

Taxes on individual or household income consist of personal income taxes, including those deducted by employers (pay-as-you-earn taxes), and surtaxes.

Taxes on international transactions

Taxes on international transactions consist of taxes on travel abroad, foreign remittances, foreign investments, etc except those payable by producers (such taxes payable by producers are part of taxes on production while those payable by non-producers are part of other current taxes); they are part of “miscellaneous current taxes”.

Taxes on lotteries, gambling and betting

Taxes on lotteries, gambling and betting consist of any taxes, other than taxes on winnings, which are levied on these types of operations; they are typically levied as a percentage of the operator’s turnover.

Taxes on pollution

Taxes on pollution consist of taxes levied on the emission or discharge into the environment of noxious gases, liquids or other harmful substances; they do not include payments made for the collection and disposal of waste or noxious substances by public authorities.

Taxes on production and imports

Taxes on production and imports consist of taxes payable on goods and services when they are produced, delivered, sold, transferred or otherwise disposed of by their producers plus taxes and duties on imports that become payable when goods enter the economic territory by crossing the frontier or when services are delivered to resident units by non-resident units; they also include other taxes on production, which consist mainly of taxes on the ownership or use of land, buildings or other assets used in production or on the labour employed, or compensation of employees paid.

Taxes on products

Taxes on products, excluding VAT, import and export taxes, consist of taxes on goods and services that become payable as a result of the production, sale, transfer, leasing or delivery of those goods or services, or as a result of their use for own consumption or own capital formation.

Taxes on specific services

Taxes on specific services consist of all taxes assessed on the payment for specific services such as taxes on transportation, communications, insurance, advertising, hotels or lodging, restaurants, entertainments, gambling and lotteries, sporting events, etc.

Taxes on the income of corporations

Taxes on the income of corporations consist of corporate income taxes, corporate profits taxes, corporate surtaxes, etc.

Taxes on the use of fixed assets

Taxes on the use of fixed assets include taxes levied periodically on the use of vehicles, ships, aircraft or other machinery or equipment used by enterprises for purposes of production, whether such assets are owned or rented.

Taxes on winnings from lotteries or gambling

Taxes on winnings from lotteries or gambling are taxes payable on the amounts received by winners.

Taxes paid to obtain business and professional licences

Taxes paid to obtain business and professional licences consist of those taxes paid by enterprises in order to obtain a licence to carry on a particular kind of business or profession; in some circumstances when the payments are not unrequited they should be treated as payments for services rendered.

Taxes resulting from multiple exchange rates

Taxes resulting from multiple exchange rates consist of implicit taxes resulting from the operation of an official system of multiple exchange rates by the central bank or other official agency.

Time of acquisition

The time at which goods and services are acquired is when the change of ownership occurs or the delivery of the services is completed.

Törnqvist price index

A Törnqvist price index is a weighted geometric average of the price relatives using arithmetic averages of the value shares in the two periods as weights.

Törnqvist volume index

A Törnqvist volume index is a weighted geometric average of the quantity relatives using arithmetic averages of the value shares in the two periods as weights.

Total economy

The total economy consists of all the institutional units which are resident in the economic territory of a country.

Total final consumption

Total final consumption is the total value of all expenditures on individual and collective consumption goods and services incurred by resident households, resident NPISHs and general government units; it may also be defined in terms of actual final consumption as the value of all the individual goods and services acquired by resident households plus the value of the collective services provided by general government to the community or large sections of the community.

Total hours worked

Total hours worked consist of the aggregate number of hours actually worked during the period in employee and self-employment jobs.

Trade margin

A trade margin is the difference between the actual or imputed price realised on a good purchased for resale (either wholesale or retail) and the price that would have to be paid by the distributor to replace the good at the time it is sold or otherwise disposed of.

Transaction

A transaction is an economic flow that is an interaction between institutional units by mutual agreement or an action within an institutional unit that it is analytically useful to treat like a transaction, often because the unit is operating in two different capacities.

Transfer

A transfer is a transaction in which one institutional unit provides a good, service or asset to another unit without receiving from the latter any good, service or asset in return as counterpart.

Transfer in kind

A transfer in kind consists either of the transfer of ownership of a good or asset, other than cash, or the provision of a service, without any counterpart.

Transport margin

A transport margin consists of those transport charges paid separately by the purchaser in taking delivery of the goods at the required time and place.

Unincorporated enterprise

An unincorporated enterprise is a producer unit which is not incorporated as a legal entity separate from the owner (household, government or foreign resident); the fixed and other assets used in unincorporated enterprises do not belong to the enterprises but to their owners, the enterprises as such cannot engage in transactions with other economic units nor can they enter into contractual relationships with other units nor incur liabilities on their own behalf; in addition, their owners are personally liable, without limit, for any debts or obligations incurred in the course of production.

Unit value index

A unit value index is a "price" index which measures the change in the average value of units that are not homogeneous and which may therefore be affected by changes in the mix of items as well as by changes in their prices.

Uses

The term uses refers to transactions in the current accounts that reduce the amount of economic value of a unit or sector (for example, wages and salaries are a use for the unit or sector that must pay them); by convention, uses are put on the left side of the account.

Uses of value added quadrant

The uses of value added quadrant (of an input-output table) shows those production costs of producers other than intermediate consumption.

Valuables

Valuables are produced assets that are not used primarily for production or consumption, that are expected to appreciate or at least not to decline in real value, that do not deteriorate over time under normal conditions and that are acquired and held primarily as stores of value.

Value added – gross

Gross value added is the value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry or sector; gross value added is the source from which the primary incomes of the SNA are generated and is therefore carried forward into the primary distribution of income account.

Value added – net

Net value added is the value of output less the values of both intermediate consumption and consumption of fixed capital.

Value added tax (VAT)

A value added tax (VAT) is a tax on products collected in stages by enterprises; it is a wide-ranging tax usually designed to cover most or all goods and services but producers are obliged to pay to government only the difference between the VAT on their sales and the VAT on their purchases for intermediate consumption or capital formation, while VAT is not usually charged on sales to non-residents (i.e. exports).

VAT – deductible

Deductible VAT is the VAT payable on purchases of goods or services intended for intermediate consumption, gross fixed capital formation or for resale which a producer is permitted to deduct from his own VAT liability to the government in respect of VAT invoiced to his customers.

VAT – invoiced

Invoiced VAT is the VAT payable on the sales of a producer; it is shown separately on the invoice which the producer presents to the purchaser.

VAT - non-deductible

Non-deductible VAT is VAT payable by a purchaser which is not deductible from his own VAT liability, if any.

Vertically integrated enterprise

A vertically integrated enterprise is one in which different stages of production, which are usually carried out by different enterprises, are carried out in succession by different parts of the same enterprise (the output of one stage becomes an input into the next stage, only the output from the final stage being actually sold on the market).

Volume index

A volume index is most commonly presented as a weighted average of the proportionate changes in the quantities of a specified set of goods or services between two periods of time; volume indices may also compare the relative levels of activity in different countries (e.g. those calculated using PPPs).

Wages and salaries

Wages and salaries consist of the sum of wages and salaries in cash and wages and salaries in kind.

Wages and salaries in cash

Wages and salaries in cash consist of wages or salaries payable at regular weekly, monthly or other intervals, including payments by results and piecework payments; plus allowances such as those for working overtime; plus amounts paid to employees away from work for short periods (e.g. on holiday); plus ad hoc bonuses and similar payments; plus commissions, gratuities and tips received by employees.

Wages and salaries in kind

Wages and salaries in kind consist of remuneration in the form of goods and/or services that are not necessary for work and can be used by employees in their own time, and at their own discretion, for the satisfaction of their own needs or wants or those of other members of their households.

Work-in-progress – inventories

Inventories of work-in-progress consist of goods and services that are partially completed but that are not usually turned over to other units without further processing or that are not mature and whose production process will be continued in a subsequent period by the same producer.

Work-in-progress on cultivated assets – inventories

Inventories of work-in-progress on cultivated assets consist of livestock raised for products yielded only on slaughter, including fowl and fish raised commercially, trees and other vegetation yielding once-only products on destruction and immature cultivated assets yielding repeat products.

Written-down (net) value of a fixed asset

The written-down (net) value of a fixed asset is the actual or estimated current purchaser's price of a new asset of the same type less the cumulative value of the consumption of fixed capital accrued up to that point in time.

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European Commission

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