`Appendix B

Accounts for General Equilibrium Modeling in IGEM

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Appendix B. Industry-Level Production Accounts for Econometric General Equilibrium Modeling

B.1 Introduction.

The econometric approach to general equilibrium modeling employed in IGEM is based on a new system of national accounts for the United States. The distinctive feature of these accounts is that demands and supplies of commodities and factors of production are presented in both current and constant prices. Traditional systems of accounts give the final demands that make up the gross domestic product (GDP) in current and constant prices. The factor supplies that generate gross domestic income (GDI) are presented only in current prices.

Before the introduction of econometric approach to general equilibrium modeling summarized by Jorgenson (1998a), macro-econometric modeling was essentially limited to the demand side of the economy. As we have emphasized in Chapter 1 of *Double Dividend*, parameters required for supply-side modeling in computable general equilibrium models were chosen largely by calibration to a single data point, following Johansen (1960). These modeling strategies were the consequence of the limitations of official systems of national accounts.

The new architecture for the U.S. national accounts presented by Jorgenson and Landefeld (2006) and updated by Jorgenson (2009b) provides data on the price and quantity of capital services for all assets in the U.S. economy. This is essential for intertemporal general equilibrium modeling. The accumulation equation relating investment and capital stock provides the backward-looking dynamics in IGEM. The cost of capital equation relating the price of capital services to the price of capital assets imparts forward-looking dynamics to IGEM.

The new system of national accounts employed in IGEM is outlined in Chapter 2 of *Double Dividend*. The demand side coincides with the U.S. National Income and Product Accounts (NIPAs), the official system of national accounts prepared by the Bureau of Economic Analysis (BEA). The supply side includes an industry-level production account with outputs and inputs for the individual industries included in IGEM in current and constant prices. These data are used in modeling producer behavior in IGEM.

We have combined time series data on final demands for Personal Consumption Expenditures (PCE) from the NIPAs with micro-economic data in modeling consumer behavior.

The Consumer Expenditure Survey (CEX) by the Bureau of Labor Statistics (BLS) reflects the enormous heterogeneity of individual households that is typical of microeconomic data sets. The CEX provides the information needed to incorporate the demographic characteristics of households into our model of consumer behavior.

In modeling the behavior of the government sector, we have employed data on final demands by governments from the NIPAs. Similarly, our model of investment expenditures incorporates demand-side data on Gross Private Domestic Investment (GPDI) from the NIPAs. Finally, our models of the demand for imports and the supply of exports are based on time series data on imports and exports in current and constant prices. Models of this type can be found in macro-econometric models, as well as computable general equilibrium models.

Data appropriate for econometric modeling of producer behavior were generated for the U.S. by Jorgenson, Gollop and Fraumeni (1987). These data provided the empirical basis for the econometric models of production employed by Jorgenson and Wilcoxen (1990). For the version of IGEM (v18) presented *Double Dividend* (Jorgenson, Goettle, Ho and Wilcoxen 2013) the U.S. data cover the time period 1960-2005 and are based on those of Jorgenson, Ho, and Stiroh (2005). In this version we use the NAICS instead of the ISC in the earlier versions of IGEM, and the data covers the period 1947-2010. The NAICS industry account is described in Jorgenson, Ho and Samuels (2016, henceforward JHS).

Industry-level production accounts like those constructed for the United States by JHS have been incorporated into the methodology for productivity measurement presented in Schreyer's (2001) OECD productivity manual. The methods for compiling the capital data required for intertemporal general equilibrium modeling are presented in Schreyer's (2009) OECD manual on capital measurement. Jorgenson and Schreyer (2012) show that the methodology presented in these two OECD manuals is consistent with the new United Nations' (2009) *2008 System of National Accounts*.

Fortunately, industry-level production accounts are now available for a wide range of advanced countries, as a result of the completion of the EU KLEMS project in 2008. In addition to accounts for 25 of the 27 EU members, these accounts have been constructed for Australia, Canada, Japan, and Korea, as well as the United States, following the methodology of Jorgenson, Ho, and Stiroh (2005). These accounts will be extended to many emerging economies through the World KLEMS Initiative established in 2010.

In this Appendix we present the industry-level production accounts that underlie our econometric models of producer behavior in more detail. Our presentation is a revision of Appendix B in *Double Dividend* for the new version of the model, IGEM-Naics. We give production accounts for the 36 industrial sectors employed in IGEM-N, as well as the government and household sectors that complete the model.

B.2. Output and Intermediate Inputs.

In this section we present measures of industry output and intermediate inputs. Our methodology and data sources are given in more detail in Chapter 4 of Jorgenson, Ho and Stiroh (2005) and JHS (2016). The industry classification in the previous versions of IGEM reflects the focus on manufacturing in the old economy, for this IGEM-N version the classification recognizes the role of information technology and services in the Information Age while focusing on the energy-producing sectors and sectors that are intensive users of energy. Table B.1 gives the output and inputs for the 36 market industries, as well as household and government sectors.

[Table B.1 about here]

Section B.2.5 describes the data sources and our adjustments to them. The results are reported in section B.2.6 for the energy producers and in Section B.2.7 for the remaining industries. Our methodology for measuring industry output, intermediate inputs, and value added is based on a time series of input-output tables. This gives the flows of all commodities in the economy, as well as payments for capital and labor services, in current and constant prices. We account for the supply of every commodity, whether produced domestically or imported. We also describe the use of every commodity, whether consumed as an intermediate input or allocated to final demand.

Table B.1 lists the 36 industries in IGEM-N together with the industry output in 2010. Table B.3 shows the relation between these industries and the 65 sectors in the BEA's industry accounts, together with the 2002 North American Industry Classification System (NAICS) codes. The 36^{th} sector is the government industry excluding the government contributions to electricity, health and education which are combined with the respective private sector output. Households constitute a 37^{th} sector which contributes to value added (GDP) in the form of a rental flow of capital services from owner-occupied housing and consumer durables. The

government consumption component of final demand buys the output of industry 36 unlike the previous versions of IGEM where labor and capital input are directly allocated to government final demand without a government industry.

We emphasize that in the National Accounts the government enterprises sector include electric utilities. In IGEM-N, sector 6 include both private and government electric utilities to simplify the accounting. Similarly, we have also consolidated private and government education (sector 33), and private and government health services (sector 34).

The capital services of the Households sector include the service flow from consumer durables, which is excluded from the official definition of GDP. Accordingly, value added for the IGEM industries exceeds the official GDP. In the accounting of the final demand components of GDP (CIGXM), the Consumption category includes only nondurables and consumer services, while Investment includes expenditures on consumer durables. Consumer services are higher than the official accounts by the amount of the service flow imputed to durables. The imputation for owner-occupied housing is taken from the official accounts.

B.2.1. Notation

Models of producer behavior for domestic industries in IGEM are presented in Chapter 4 of *Double Dividend*. For convenience we repeat the definitions of key variables that describe the outputs, the inter-industry flows of goods and services, and the flows of capital and labor services. The subscript *i* refers to commodities, while *j* refers to industries. The variables are:

i	index for commodity, $i=1,...,M$
j	index for industry, $j=1,...,M$
t	index for time, $t=1947,1978,...,2010$
QI_j	quantity of gross output of industry j
VQI_j	nominal value of gross output of industry j
PO_j	price of gross output to producers in industry j
PI_i	price of gross output to purchasers from industry j
QP_i^j	quantity of commodity input i into industry j
PS_i	price of commodity i to buyers
KD_j	quantity of capital input in industry j

LD_j quantity of labor input in industry *j*

E_j index of energy intermediate input into *j*

M_j index of total non-energy intermediate input into *j*

$P_{E,j}$ price of energy intermediate input into *j*

$P_{M,j}$ price of total non-energy intermediate input into *j*

PKD_j price of total capital input to industry *j*

PLD_j price of total labor input to industry *j*

QC_i quantity of domestically produced commodity *i*

PC_i price of domestically produced commodity *i*

M_i quantity of comparable imports of commodity *i*

PM_i price of imported commodity *i*

QS_i quantity of total supply of commodity *i*

$M_{j,i}$ MAKE matrix; value of commodity *i* made by industry *j*

B.2.2. Prices and Quantity Indexes

Our industry models of production are based on production functions with industry outputs expressed as functions of capital, labor, and intermediate inputs. Each industry, indexed by *j*, has its own production function and purchases *M* distinct intermediate inputs. We group intermediate inputs into energy and non-energy aggregates. Production functions are assumed to be separable in these groups and may be written:

$$QI_j = f(KD_j, LD_j, E_j, M_j, t); \qquad E_j = E(QP_3^j ...); \qquad M_j = M(QP_1^j, ...) \tag{B.1}$$

where *KD* is capital services, *LD* is labor services, *E* is an index of energy intermediate inputs – Oil Mining, Gas Mining, Coal Mining, Electric Utilities, Gas Utilities and Petroleum Refining, – and *M* is an index of non-energy materials inputs, comprising the 30 non-energy commodities.

The production model (B.1) is used for the 35 market industries and 1 government industry. The Household sector also rents capital services but that is driven by the consumption model. The production functions for these industries are described at the end of this section. The *M* commodity inputs correspond to the primary products of the 36 industries.

Under the assumptions of constant returns to scale and competitive markets, the value of output is equal to the value of all inputs:

$$\text{(B.2)} \quad PO_{jt}QI_{jt} = VQI_{jt} = PKD_{jt}KD_{jt} + PLD_{jt}LD_{jt} + P_{Ejt}E_{jt} + P_{Mjt}M_{jt}$$

$$P_{Ejt}E_{jt} = PS_{3t}QP_{3t}^{j} + PS_{4t}QP_{4t}^{j} + .. + PS_{31t}QP_{31t}^{j}$$

$$P_{Mjt}M_{jt} = PS_{1t}QP_{1t}^{j} + PS_{2t}QP_{2t}^{j} + .. + PS_{NCI,t}QP_{NCI,t}^{j}$$

where PO_j denotes the price of output, PS_i denotes the price of each commodity and the time subscript has been dropped for brevity. The price of industry capital services, PKD_j, is defined as a residual, so that (B.2) holds as an accounting identity. The price of labor services PLD_j and the price of capital services are discussed in Double Dividend Appendix B.

For the sample period we assume that the price of the *i*th intermediate input, PS_i , is the same for all purchasing sectors. IGEM allows for different tax rates that result in different input prices for the same good for different industries, but that feature is only used in policy simulations. We note that in the actual complex economy, each of the IGEM sectors is an aggregate with many components. Therefore, each input QP_i^j is a commodity bundle consisting of these components. Even if the prices of all of the components were the same for all purchasers, differences in the composition of inputs among industries would have generated a different input price PS_i for each purchasing industry.

Our aggregation over industries is based on the Tornqvist quantity index, which provides a close approximation to the Fisher ideal index currently employed in the NIPAs. The Tornqvist quantity index is an exact index number that replicates the translog model used in IGEM.[1] The energy index for industry j is:

$$\text{(B.3)} \quad \Delta \ln E_{jt} = \sum_{i=3,4,16,30,31} \overline{v}_{ijt} \Delta \ln QP_{it}^{j}$$

where $\Delta \ln X_t \equiv \ln X_t - \ln X_{t-1}$ is the growth rate.

The weights in the Tornqvist quantity index are shares of the component in the total value of the industry's energy inputs defined as[2]:

[1] See Diewert (1976).

[2] The same subscript *i* is used in the numerator and denominator of Equation (B.4) to avoid a proliferation of symbols.

(B.4) $$v_{ijt} = \frac{PS_{it} QP_{it}^{j}}{\sum_{i=3,4,16,30,31} PS_{it} QP_{it}^{j}}$$

The two-period average value share is:

(B.5) $$\overline{v}_{ijt} = \tfrac{1}{2}\left(v_{ijt} + v_{ijt-1}\right).$$

The *price index of aggregate energy input, P_{Ej},* is defined implicitly to make the following value identity hold:

(B.6) $$P_{Ej} E_j = \sum_{i=2,3,4,6,7,23} PS_i \, QP_i^j$$

We construct a similar set of index numbers for non-energy input defined over the set $I_{Mat} = \{1, 5, 8, ...36\}$:

(B.7) $$\Delta \ln M_{jt} = \sum_{i=I_{Mat}} \overline{v}_{ijt} \Delta \ln QP_{it}^{j}$$

$$P_{Mj} M_j = \sum_{i=I_{Mat}} PS_i \, QP_i^j$$

Equations (B.3) and (B.7) represent growth rates of energy and non-energy inputs, so that we normalize prices at unity in the base year,

$P_{Ej,t=base} = P_{Mj,t=base}$ =1.0.

We emphasize that the prices of energy and non-energy inputs are specific to each industry, even though prices of the component inputs are the same for all industries. This reflects differences in the shares of intermediate inputs in the value of output among industries.

We distinguish between purchasers' and producers' prices; the value to the purchaser is the value of output to the producer, plus output taxes paid on *j*'s output, T_j:

(B.8) $$VQI_j = PI_j QI_j = PO_j QI_j + T_j$$

The purchaser's price *PI* is defined in (2.12) of *Double Dividend*.

V*alue added, inclusive of taxes,* of industry *j* is the sum of payments for capital, labor, and indirect taxes:

(B.9) $$VA_{jt}^{T} = PKD_{jt} KD_{jt} + PLD_{jt} LD_{jt} + T_{jt}$$

Gross Domestic Product (GDP) in nominal terms is then given by the sum of value added over all sectors, including the government and households:

(B.10) $$GDP = \sum_j VA_{jt}^T$$

B.2.3. Inter-Industry Accounts.

The basic building block for our measures of output and intermediate inputs is a time series of inter-industry transactions tables. These tables describe the industries that produce each product and the industries that use them. The Use table allocates the supply of each commodity among the categories of intermediate input and final demand. The Make table shows how each commodity is supplied or made by the various industries. Each industry produces a primary commodity and, possibly, some secondary commodities. Each commodity is produced by one or more industries.

The inter-industry transactions tables for our industry classification have dimension 36 x 36. To illustrate the concepts that underlie our industry-level production accounts, we give a condensed 3-sector Use table for year 2010 in Table B.2a, and a Make table for 2010 in Table B.2b. The three industries are Primary Energy (oil, gas, coal mining), Secondary Energy (utilities and refining), and Non-energy (all other industries). The final demanders are household consumption (C), general government (G), Investment (I) and Exports (X). The supply from Imports (M) is entered as a negative number.

[Table B.2 about here]

A key consistency requirement for IGEM is that the output of a given commodity by all industries must be equal to the use of this commodity by other industries and final demanders. On the input side, the *j*th column of the Use table represents the inputs of that industry. Equations (B.2) and (B.8) may be combined to express the constraint that the sum of inputs is equal to the value of industry output to the purchaser:

(B.11) $$PI_j QI_j = \sum_i PS_i QP_i^j + PKD_{jt} KD_{jt} + PLD_{jt} LD_{jt} + T_j$$

On the output side, each industry produces many commodities and the exact composition is given by the Make table. The *j*th row of the Make table gives the values of the various commodities produced by industry *j*, and the row total is the industry output:

(B.12) $$PI_j QI_j = \sum_i M_{j,i}$$

The *i*th column of the Make table gives the contributions of each industry to the domestic output of the *i*th commodity. Let QC_i denote the quantity of domestically produced commodity *i*, PC_i

the price, and VC_i the value. The Make column total is the value of total domestic output of each commodity, summed over all the supplying industries:

(B.13) $$VC_i = PC_i QC_i = \sum_j M_{j,i}$$

We explain the division of the value into price and quantity later in equation (B.20).

These concepts are illustrated in Table B.2. The Primary Energy industry is represented by the *Pri. Energy* column in the Use table and the *Pri. Energy* row in the Make table; the *Primary Energy* commodity is in the corresponding row of the Use table and column of the Make table. The Primary Energy industry output is $PI_{j=P.E.} QI_{j=P.E.} = 267$ billion dollars, and the value of domestically produced Primary Energy commodity is $PC_{i=P.E} QC_{i=P.E.} = 243$ billion. The value added of the industry is $VA^T_{j=P.E.} = 167$ billion. The value of Primary Energy commodities as intermediate inputs into the Secondary Energy industry is $PS_1 QP_1^{j=2} = 459.1$ billion.

The Use table also includes the familiar breakdown of sales to final demand – consumption, investment, government, exports, and imports. In the summary Use Table B2, these are the columns marked C, I, G, X, and M. The official U.S. Inter-industry Transactions Accounts distinguish between two types of imports – comparable and non-comparable – however, we have consolidated them in our accounts into the M column. The imports of commodity *i*, denoted by M_i , is the sum of the comparable and non-comparable imports of *i* in the official IO tables.

The sum of all the elements in row *i* of the Use table equals the value of deliveries of the *i*th commodity to all users – intermediate inputs to other industries and final demand. Thus, the supply-demand balance for domestic commodity *i* in value terms is:

(B.14) $$PC_i QC_i = \sum_j PS_i QP_i^j + PS_i (c_i + i_i + g_i + x_i) - PM_i M_i$$

The domestic commodity totals are given in the right-most column of Table B.2a. It is more intuitive, however, to rewrite this as the total supply from domestic suppliers and competitive imports, equal to total demand:

(B.15) $$PC_i QC_i + PM_i M_i = \sum_j PS_i QP_i^j + PS_i (c_i + i_i + g_i + x_i)$$

Relating (B.15) to Table B2a we see that in the Primary Energy row of the Use table the $243 billion of the domestic commodity is augmented by imports of $284.8 billion, giving a total

supply of $528 billion. Excluding exports of $12.6 billion, the total supply of $528 billion to the domestic market is divided among $514.4 billion for intermediate demand and $1.0 for Investment. That is,

$$PC_{i=P.E.}QC_{i=P.E.} = 243$$

$$PM_{i=P.E.}M_{i=P.E.} = 284.8$$

The key assumption necessary for a quantity version of (B.15) to hold is that all industries and final demand categories purchase the same commodity bundle of commodity *i* with the same share of the imported variety. Let QS_i denote the quantity of total supply of commodity *i* and PS_i the price. The total value of supply for each commodity is then:

(B.16) $$PS_iQS_i = VS_i = PC_iQC_i + PM_iM_i$$

The quantity of the total supply of commodity *i* is a Tornqvist index of the domestic and imported varieties:

(B.17) $$\Delta \ln QS_i = (1-\overline{v}_m)\Delta \ln QC_i + \overline{v}_m \Delta \ln M_i$$

where the weights are (averaged) value shares:

(B.18) $$v_{mt} = \frac{PM_{it}M_{it}}{VS_{it}}$$

The price PS_i is defined implicitly from the total supply and the quantity index in (B.17):

(B.19) $$PS_i = \frac{VS_i}{QS_i}$$

We have now completed the circle in the inter-industry flow of goods. The price PS_i of commodity *i* is the price paid by producers for their input in B.2, which was introduced at the beginning of our description of the input-output system. In other words, the input of commodity *i* bought by industry *j*, denoted by QP_i^j in B.2 and B.3, is a composite good made up of imports M_i and the domestic variety QC_i, which is in turn composed of output from domestic industries through (B.13).

Finally, we note that the Bureau of Economic Analysis does not produce an official input-output table in constant dollars. The final demands – C, I, G, X, and M – are based on purchasers' prices, where components of final demand are made up of many input-output

commodities.[3] However, purchasers' prices for the components of final demand are not linked to the producers' prices. Our accounting system, involving the price indexes *PO, PI, PC,* and *PS,*, is not used by the BEA in estimating the real expenditure GDP.

In the growth accounting methodology used in IGEM, we take the industry output quantities and prices to be primary data. Each commodity is regarded as a Cobb-Douglas aggregate of the quantities produced by the various industries, and its price, PC_i, is given by the component industry prices:

$$\text{(B.20)} \quad \ln PC_i = \sum_j \frac{M_{ji}}{VC_i} \ln PI_j$$

With this commodity price, the quantity, QC_i , is given by (B.13).

B.2.4. Household and Government Sectors.

In the previous versions of IGEM we followed the conventions in the 1992 benchmark IO table which does not specify a government industry and account for commodity purchases by the government in the final demand columns. In this NAICS version we follow the 2002 IO conventions and specify a government industry that purchases intermediates and hires labor and capital (our industry 36). The government columns in the final demand section of the official Use Table consist of two types; (1) the government consumption columns has only 1 input which is the commodity produced by the government industry, (2) the government investment columns may purchase any commodity but no value added. We follow these 2002 conventions but simplify to having only one grand government final demand column. Thus all of government value added is given by KD_{36} and LD_{36}.

There is no market for government output, so we define the price of sector 36 as the output price as the aggregate of the input prices so that TFP growth is identically zero. The value added of the government industry is the sum of compensation of labor and depreciation of capital. The value of the capital service flow using only depreciation is much smaller than the corresponding service flow using the price of capital services for the private capital. We

[3] For example, in the GDP accounts for Personal Consumption Expenditures, the item "footwear" consists of the IO commodities rubber products, leather products, scrap, transportation and trade. A bridge table linking the two concepts is given for each benchmark year, for 2002 this is Appendix C in the *Survey of Current Business*, October 2007.

implement the complete service flow for the government sector and impute the value of capital services and output.

The output and input of the Household industry consists of capital service flows from owner-occupied housing and consumers' durable goods. The NIPAs make imputations for the rental-equivalent value of owner-occupied housing, but no imputations are made for the capital services of other household durable assets like automobiles and computers. By contrast, we treat the flow of services from the stock of consumers' durables symmetrically with the services from housing. We regard all assets that do not depreciate within a year as providing an annual flow of services to be estimated and incorporated into output. We include purchases of new durables in investment rather than personal consumption expenditures.

The value of capital services for the Household industry is denoted by $PKD_C KD_C$ to be symmetric with the flow of capital services for the business industries. The output of the Household industry consists solely of capital services, so output is not defined as in (B.1) for a business industry, but is equal to input:

(B.21) $PI_{37} QI_{37} = PKD_C KD_C$

B.2.5. Data Sources and Adjustments

Our NAICS based industry accounts have been used to calculate the sources of growth in Jorgenson, Ho and Samuels (2016). These data are available at www.worldklems.net and described in the Data Appendix that accompanies it. We briefly summarize it here. In the previous versions of IGEM based on the SIC classification we interpolated a time series of input-output tables using the official benchmarks provided every 5 years, and estimates by the BLS Office of Employment Projections. In December 2011 the BEA provided us with a preliminary estimate of a time series of Use and Make tables based on NAICS covering 1947-1997 that is consistent with the regular official annual tables given for 1998+. We made use of these estimates to construct a time series based on our industry classification. (In 2016, the BEA officially released a revised version of these historical IO tables in NAICS, covering 1947-2014.)

B.2.5.1 Adjusting the BEA annual IO tables

The BEA Industry Economic Accounts Directorate has been preparing "annual" input-output tables that are extrapolated from the benchmark tables regularly since the release of the

1997 benchmark in 2002. The data series covering 1998-2010 was released in December 2011. These consist of Use and Make tables for 65 sectors based on NAICS-2002; i.e. the same 65 sectors as those in the most recent version of the GDP by Industry accounts[4]. (The Income and Employment tables in the NIPA cover a similar set of industries; e.g. Table 6.17D gives Corporate Profits for these industries plus three more. See *Survey of Current Business*, August 2011). These annual inter-industry transaction tables are based on the more detailed benchmark table for 2002 that covered 426 industries, 8 of which are government sectors.

In 2011, the BEA also made available Use and Make tables based on the same 65 NAICS sectors, covering the period 1963-1997. A separate series is given for a more aggregated list of 46 industries for 1947-62. These IO tables were estimated by Mark Planting based on the 1997 Benchmark IO that was revised to be consistent with the GDP given in the 2011 Annual Revision of the NIPA. We first expanded the 46-sector tables (1947-62) to the 65 sectors using historical industry output data in the SIC system, including price data from Jorgenson, Gollop and Fraumeni (1987). Next we took the official annual tables for 1998-2010 and reorganized them to match the format used by Planting (adjusting the imports and rest-of-world rows and final demand columns). We then simplified the system by eliminating the scrap, used-goods and rest-of-the-world sectors, consolidating them into the other rows and columns. Let us label the resulting Use and Make tables the BEA-J65 set.

The next step is to disaggregate the 65 sectors in the BEA-J65 tables to our 87-industry list that includes detail on the Information Technology, Electric Utility and other sectors. For example, Mining except oil and gas is disaggregated to Coal Mining and Non-energy Mining; Utilities is split into Electric Utilities, Gas Utilities and Water systems; Government enterprises is split into Electric Utilities and Other Enterprises; Real Estate is split into owner-occupied housing versus the rest (the splits are shown in Table A1 of the Data Appendix). These splits are made using information in the detailed benchmark input-output tables and estimates from the BLS that cover about 200 sectors (we refer to these as BLSIO below).

The above set of expanded industries has been used to study the historical growth record in JHS(2014). From this set of 87 industries we consolidated them to the 36 IGEM sectors. The

[4] Both input-output tables and GDP by industry data are given at http://www.bea.gov/industry/index.htm#annual.

relation between the IGEM sectors and the BEA65 sectors in the National Accounts is given in Table B.3 together with the NAICS codes.

[Table B.3 about here]

B.2.5.2. Industry and commodity prices

The *GDP by Industry* data for 426 industries on the BEA's web site give gross output and prices for 1998-2010. We aggregate over the 426 industries to obtain industry prices for our classification for these years, using the Tornqvist index. Next, we use the Make matrices constructed above to derive commodity prices from these industry output prices.

For years prior to 1998 we turn to the BLS Office of Employment Projections time series for output and prices. We extrapolate prices for 1972–1997 using BLS industry data for 195 NAICS industries covering the period 1972-2008 released in July 2009. For the years 1960-1972 we use the data in Jorgenson, Ho, Samuels and Stiroh (2007) for 88 industries in the SIC that was bridged to the DJA98 NAICS. For 1947-1960 we turn to the data for 51 SIC industries in Jorgenson, Gollop and Fraumeni (1987). These were allocated to the our industries using a simple correspondence such as allocating all of Primary Metals (SIC) to Primary Metals (NAICS).

B.2.5.3. Import prices and total supply prices

The price of the aggregate supply of a commodity is the weighted average of the domestic variety and the imported one. We thus need prices of imports of the corresponding commodities. Of the 65 sectors, 39 are services and of these, 20 service sectors have zero imports. Note that the conventions of the US Use table give the value of imports of *i* inclusive of tariffs, and as a negative entry, and put the total value of duties collected as a positive number in the Wholesale Trade row; with this system the column total for Imports is the import value of the U.S. in world prices and the row total for *i* is the domestic commodity output. That is, the column total is the value of M in the equation GDP=C+I+G+X-M.

The main source of import price indices is the Bureau of Labor Statistics, Division of International Prices which has been compiling prices in NAICS for 2006 onwards[5]. Prior to that,

[5] The import prices are given at http://www.bls.gov/mxp/ .

data is estimated for the SITC system, the Harmonized system and other classifications. The price indices are made available at very detailed levels and also at the 2-digit and 3-digit levels that we are concerned with in this study.

For the NAICS data during 2006-2010 the correspondence to our 65 commodities is straightforward for all the manufacturing groups. For service imports we turn to the estimates from the BEA given in the Balance of Payments accounts and NIPA (Table 4.2.4).

For the earlier 1977-2005 period when prices are given in the SITC we constructed a bridge between the 3-digit SITC codes and our sectors. The prices at the 3-digit level were aggregated up using the import values from the BLSIO NAICS data for 1983 – 2000 covering 190 industries, BLSIO SIC data for 1983-2000 covering 192 industries, and BLSIO SIC data for 1977 – 1995 covering 185 industries. For the period prior to 1977 we use the import prices developed in Ho (1989) for 35 SIC commodities.

The BLS indices are based on either f.o.b. or c.i.f. prices (see BLS Handbook of Methods[6], 1997, Chapter 15). This means that tariffs and duties are not included. Duties collected are estimated by the US International Trade Commission at detailed NAICS codes and also at 3- and 4-digit levels (http://dataweb.usitc.gov/).

A.2.5.4 Supply Prices and Input Prices

The total supply of commodity *i* is the aggregate of the domestic and imported varieties as given in B.17 above. We compute the price of total supply, PS_{it}, as the Tornqvist index of the domestic and import prices; PC_{it} and PM_{it}. The values of commodity output and imports are those in the Use table. This PS_{it} is the price that consumers pay for their consumption goods and producers pay for their intermediate inputs. This is assumed to be common to all purchasers, i.e. we assume that industry *j* and industry *k* pays the same price for "Machinery". The price for total intermediate input for each industry *j* is, however, specific to each industry since we use information for the value of each commodity input. For example the price of the energy bundle to industry *j* is:

$$\text{(B.22)}\quad \ln\frac{PE_{jt}}{PE_{jt-1}} = \sum_{i\in\text{energy group}} \tfrac{1}{2}(w_{it}^{j} + w_{it-1}^{j}) \ln\frac{PS_{it}}{PS_{it-1}}\,; \qquad w_{it}^{j} = PS_{it}QP_{it}^{j} \,/\, \sum_{k} PS_{kt}QP_{kt}^{j}$$

[6] The Handbook is available at http://stats.bls.gov/opub/hom/homtoc.htm .

B.2.6. Input, Output and Prices of Energy Sectors

In the BEA65 set of industries only 4 are related to energy giving insufficient detail for our purposes and we turn to the BLSIO tables with about 200 sectors. In the most recent version of the BLSIO data ten of the 192 industries are assigned to the six energy-related IGEM industries – (2) Oil Mining (3) Gas Mining (4) Coal Mining (6) Electric Utilities (7) Gas Utilities (23) Petroleum products. There is no breakup of Oil & Gas Mining in either BEA or BLS IO accounts and we turn to other Census data to split it.

To represent the input structure for these 6 industries we present their columns in the 2010 Use table in Table B.4. In the column for Electric Utilities we see that gross output is $283.6 billion, which is split between $34 billion for intermediate inputs and $250 billion for value added. The largest intermediate inputs for Electric Utilities are Coal Mining ($6.4 billion), Services ($16.5b) and Gas Mining ($6.2b). Output from Gas Utilities is $120 billion and the major inputs are value added ($44b) and Gas Mining ($60b). Output from Petroleum Refining was $644 billion; this is an industry with a volatile share of value added given the volatility of the price of crude oil inputs.

[Table B.4 about here]

The use of the six energy commodities by the 36 industries and final demand in 2010 are given in Table B.5. The six energy industries purchase essentially all the commodity output of Coal Mining, Oil Mining and Gas Mining, with Chemicals accounting for most of the remainder. By contrast, Petroleum Products, Electric Utilities, and Gas Utilities are used in substantial quantities by all industries and Final Demand.

[Table B.5 about here]

Turning to the detailed Make table summarized in Table B.6, the total Electric Utilities commodity supplied by U.S. sources is worth $274.6 billion in 2010, of which about 20% is supplied by government owned utilities. The total gas commodity supplied by Gas Utilities is worth $130.9 billion in 2010. Of this total, $112.5 billion comes from Gas utilities industry, $9.7 comes from Electric Utilities, and $8.7 from other industries. It is important not to identify gas supplied with the output of Gas Utilities, since this industry does not provide all of gas supplies.

[Table B.6 about here]

The prices of the various forms of energy have shown substantial movements in the 1960-2010 period, relative to the prices of other commodities. Figure B.1 shows how the prices

of the three industries producing primary fuels – coal, oil and gas – changed relative to the GDP deflator. These graphs are normalized with prices for 2005 equal to unity. The price of oil rose from about 0.3 during the 1960s to about 1.0 during the oil shocks of the 1970s. The relatively stable prices of the 1990s gave way to a sharp rise in the mid-2000s. The price of gas was quite similar to crude oil until 2005 when it did not follow the big oil inflation and fell in the late 2000s. The price of coal also rose substantially in the first oil shock, but declined steadily until 2000; it stayed stable for much of the 2000s until an increase in 2008.

[Figures B.1, B.2 about here]

The prices of the secondary energy industries are given in Figure B2 and showed less extreme movements than the fossil fuel prices. The prices of Refined Petroleum and Gas Utilities have largely followed the crude oil price and gas price. The price of delivered electricity (i.e. generation plus transmission) showed a very different behavior from the price of coal or oil given that Electric Utilities are highly regulated. After a substantial rise in the 1970s relative to the GDP deflator, it declined slightly until 2000, and then rose by 20% by 2010.

B.2.7. Output and Intermediate Input by Industry

We next consider gross output levels and growth rates for all 36 industries. The data described above are used in estimating the behavioral models in IGEM (v20); the same underlying data for 65 BEA industries is also used in JHS (2016) to analyze the sources of U.S. growth. In this section we provide some key details on industry characteristics and growth.

B.2.7.1 Output and Inputs in 2010

Table B.1 gives the value of output, energy and non-energy intermediate inputs and value added for each industry in 2010. The largest industry in terms of output is Finance and Insurance ($2,305 billion), followed by Business Services ($2,298 billion). The six energy sectors together produce a gross output of $1,276 billion; this figure includes substantial intra-industry transactions among the six sectors. In the case of Coal Mining, the output excluding the intra-industry sales is only 90% of industry gross output.

The sum of value added over all sectors is the GDP at factor cost, $15.7 trillion by our definitions (16.1 trillion including indirect taxes). This is higher than the official GDP of $14.5 trillion due to our imputation of services from consumer durables and our method of imputing owner-occupied housing services. In terms of value added, Business Services is the largest

business industry with $1575 billion in 2010, followed by Health care & social services. The six energy industries have $592 billion worth of value added or 3.8% of GDP in 2010.

There is a wide range of variation in the split of gross output between value added and intermediate inputs, as shown in Figure B3 for 2010. The bars for the six energy industries are light colored while the non-energy industries are in dark bars. Of the nine industries with the highest value added to output ratio in 2010, three are energy-related with a large capital input – Electric Utilities has 87%, Gas Mining 62% and Oil Mining 61%. At the other end of the scale, the Petroleum Refining and Gas Utilities are heavy intermediate input-using industries with value-added to output ratios of about 30%.

[Figure B.3 about here]

International trade plays very different roles in the different sectors. In Table B.7 we give exports and (comparable) imports for each of the 26 commodities, as well as the shares of domestic output. The overall ratio of imports to GDP in 2010 was 15%; however, for the individual commodities the share ranges from 245% in Oil Mining and 213% in Textiles-Apparel-Leather to less than 1% for various services. For the energy sectors, the import share for Electricity was 1.3%, Gas Mining was 18%, and Petroleum Refining was 12%. The U.S. is now a coal exporter with exports up to 15% of domestic commodity output in 2010. There are very small trade flows for Gas Utilities and net electricity exports were close to 0. We note that in 2010 the U.S. was running a substantial trade deficit and a balanced trade configuration would look quite different.

[Table B.7 about here]

B.2.7.2 The growth of industry output and prices, 1960-2010

We described industry output growth and the contributions to growth of capital, labor, intermediates, and productivity in Chapter 4 of *Double Dividend*. We give the updated tables for the NAICS industries in Tables 4.1-4.4. Industry output, total intermediate input, value added, capital input and employment for 2010 is given in Table 4.1 After the 2008 Financial Crisis, the Motor Vehicles industry shrunk considerably and the largest manufacturing industries by value added are now Chemicals-rubber-plastic, Food-beverage-tobacco and Petroleum Refining.

The industry with the biggest capital input (other than Households) is Real Estate ($828b) and Finance and Insurance. In the energy group, the capital input for Electric utilities and Petroleum Refining are both about $150 billion in 2010. The largest employers are Accommodation and

Other Services (21.5 million workers), Health Care (19.4) and Business Services (17.4). The energy group is capital intensive and employ 6.2% of all capital input but only 0.7% of all workers.

Table 4.2 presents growth rates of output, intermediate input, and value added for all 36 sectors for the period 1960-2010. Output growth is most rapid for the Information technology equipment (12% p.a.) and Software & information technology services (11%). During this period GDP grew at 3.0% per annum, while the IT value added grew in excess of 12%. Other industries with rapid value added growth are Wholesale trade (5.4%), Finance and insurance (4.5%), Business Services (3.8%) and Retail trade (3.6%); these are the large service sectors that transformed the post-War U.S. economy. The industries in relative decline are the mining industries, Construction, manufacturing industries facing intense import competition (Textile-apparel-leather, Primary metals).

Table 4.3 presents the sources of growth for each industry, where the growth of output is the sum of the contributions of capital, labor, intermediate inputs and productivity growth. The considerable impact of intermediate inputs on the growth of industry output is strikingly apparent, it is the key contributor to industry growth in most of the manufacturing industries, including Petroleum Refining. However, this input makes a negative contribution in Electric Utilities which has an unusually large contribution from capital input growth. Other sectors with large capital input contributions are Oil and gas mining, Natural gas distribution, and Water and sewage. Labor input makes large positive contributions to the growth of Construction, Accommodation and other services, Business services, and Health care, but is not an important contributor in the energy industries. Labor input fell in seven industries with positive output growth.

The final source of economic growth identified in Table 4.3 is the growth of productivity. Information technology equipment has the fastest productivity growth, 8.3% per year out of the 12% output growth, however, as a share contribution, Coal mining TFP growth of 0.97% out of 1.26% is the largest. Other industries with substantial TFP contributions are Agriculture, Miscellaneous manufacturing, Electrical equipment and Retail trade. At the other end, the services group and Construction have significant negative productivity growth. In the energy group, Oil and gas mining and Natural gas distribution have negative TFP growth, while Petroleum refining and Electric utilities have negligible TFP growth.

Measures of average performance over the post-War period conceal changes in trends over time. Table 4.4 provides growth rates of productivity for the 36 industries for the entire period and for the sub-periods 1947-1973, 1973-1995, and 1995-2010. Jorgenson, Ho and Samuels (2016) label these three sub-periods as "Postwar Recovery", "Long Slump" and "Growth and Recession." Productivity growth overall was highest during 1947-73, decelerated dramatically during 1973-95, and revived substantially during 1995-2007 and then falling during the Great Recession. This pattern is quite clear for the service sectors, which are large and dominate the economy. However, for the Information technology equipment industry, its fast TFP growth kept accelerating until the Great Recession, averaging 12.2% per year during 1995-2010. Other industries with consistent high productivity growth include Agriculture, Coal mining, Electrical equipment, Motor vehicles, Textiles-apparel-leather, Wholesale and Retail and Transportation.

Table B.8 gives the growth rates of output, energy and non-energy intermediates, as well as the change in prices relative to the GDP deflator over the period 1960-2010. All but seven of the 36 industries in Table B8 show a slower growth of energy input than output. This is the result of substantial energy conservation in the U.S. economy, especially in the period of the two oil shocks. The exceptions are Oil and gas mining, Natural gas distribution, Construction, Primary metals, Food and Petroleum refining. Energy input includes purchases of energy for feedstock and should not be interpreted as combustion alone. 15 industries had slower growth of non-energy intermediate than output; the other 21 saw intermediate input deepening as a result of increased specialization, outsourcing and biased technical change.

[Table B.8 about here]

Changes in the output structure comes from four major sources: (i) shifts in supply due to productivity growth, (ii) shifts in final demand due to changes in income, (iii) shifts in intermediate demands due to biases in technical change, (iv) shifts in demand due to import competition. Productivity growth in a competitive economy and in IGEM manifests itself in lower prices. In the last column of Table B.8 we give the change in prices of each commodity, relative to the GDP deflator, over the 1960-2010 period. In Figure B.4 the price growth is ranked from the biggest rise relative to the GDP deflator to the biggest fall.

[Figure B.4 about here]

The industries with the most rapid fall in prices are those with the high TFP growth – IT equipment, Software, Textiles-apparel-leather, Wholesale Trade and Publishing-broadcasting-telecommunications. Other factors contribute to changes in relative prices such as increased import competition in low-skill manufacturing and the shift in demand towards income-elastic commodities as incomes rise; however, the dominant cause is TFP growth. Of the five largest increases in relative prices, four are energy-related; Oil and gas mining prices rose by more than 3% per year, followed by Petroleum Refining at 2.1%, and Natural gas distribution at 1.9%. The large service industries also had low productivity growth and large rise in relative prices; this includes Health care, Education, Construction, and Business services. The relative price of Electricity rose at a 0.64% annual rate while the price of coal fell at 0.12% per year (i.e. price at the mine mouth).

The sectors with rapid TFP growth and declines in prices saw the largest growth in demand and this resulted in high growth rates of output. The services saw little productivity growth and higher relative prices but income effects have increased demand and these industries also had above average growth rates. Industries that faced sharp international competition such as Textiles-apparel-leather showed slow or negative growth despite good productivity growth.

As noted above, there is substantial variation in the relative growth rates over the post-War period and Table B.9 gives the growth rates for the sub-periods 1947-73, 1973-95 and 1995-2010. Overall official GDP growth decelerated from 4.0% per year during 1947-73 to 2.9% during 1973-95, and then fell further to 2.4% in the Growth and Recession period. At the industry level, the industries that followed the overall deceleration include Agriculture, Oil mining, Electric utilities, Construction, most of manufacturing except IT equipment and Other transportation equipment. Most services also decelerated except for Retail trade (peaking at 3.5% during 1973-95), Software (peaking at 15.6% during 1973-95) and Accommodation (peaking at 2.9% during 1973-95). The only industries which peaked during 1995-2010 are Gas mining and Non-energy mining. Electric Utilities grew at a rapid 5.9% during the electrification period 1947-73 and then decelerated sharply to 2.4% (1973-95) and negative growth during 1995-2010. Petroleum Refining output growth also fell sharply in the period of high prices and energy conservation.

[Table B.9 about here]

The complete time series of output for the 6 energy industries are given in Table B.10 and plotted in Fig. B5. These are in constant $2005 and the nominal values may be derived from the corresponding price data in Table B.11. The biggest sector by dollar value is Petroleum Refining and Coal Products, but Electric Utilities has fastest rate of growth over the 1947-2010 period (2.96% p.a.). The Coal mining industry has always been the smallest energy sector by value.

[Figure B.5 about here]

[Tables B.10, B.11 about here]

B.3. Measuring industry labor input

The methodology of constructing our labor input measures and the data sources for the SIC version are discussed in detail in Chapter 6 of Jorgenson, Ho and Stiroh (2005). We updated this and converted to NAICS in Jorgenson, Ho and Samuels (2016). The method to calculate effective labor input by cross-classifying workers by gender, age, and educational attainment is also summarized in Appendix B of *Double Dividend*. The *labor quality* index measures the contribution of substitution among the different types of workers and is given by the ratio of effective labor input to total hours worked. Labor quality rises and labor input grows faster than hours worked when hours worked by employees with higher marginal products (wages) grow faster than hours worked by workers with lower marginal products.

B.3.3 Results

B.3.3.1. Employment and hours worked

Table B.13 gives summary data for the labor input in the 35 industries.

First, in terms of size, there are only 1.50 million workers in the five energy- related industries in 2005 or 0.99% of total domestic employment. This includes both employees and the self-employed. Table B13 shows that within the energy group, the largest industry is Electric Utilities, private and government, with 822 thousand workers, followed by Petroleum and Gas Mining with 369 thousand.

B.6 Government accounts and taxes

Chapter 5 describes the government accounts in IGEM; how they are constructed from the National Income and Product Accounts (NIPA) for the sample period and how they are

projected using forecasts from the Congressional Budget Office (CBO). Table 5.1 gives the tax rates and values of expenditures and revenues for 2005. In this section we provide some additional detail about the sources of these expenditures and taxes.

The revenue and expenditure accounts of the Federal and State & Local governments are given in the NIPA at a very detailed level. In this version of IGEM we consider only the consolidated government, adding the Federal and State & Local, and only the main categories of taxes. The relation between model variables and the National Accounts is given in Table B28. The NIPA Tables and line numbers referenced are based on the version in the Survey of Current Business, August 2011.

[Table B28 about here]

Property taxes are the sum of the State & Local government property tax, the motor vehicle licenses paid by persons and businesses, special assessments and other taxes on persons and on production. The taxes on capital and labor in IGEM are the sum of the personal income tax and the corporate profits tax, and for simplicity, we include the rents and royalties received by the government. Similarly, the sales tax includes the excise taxes and transfers from businesses, less the subsidies paid.

The expenditure on goods and services, *VGG*, includes the purchases from the private business sector, compensation of government employees and capital consumption. This is the sum of both "current expenditures" and "investment" in the NIPA. For transfers and interest paid, recall that we consider the Social Insurance Trust Funds to be part of the household assets, and so social benefits are not counted as government transfers, G^{tran}. There is a separate item for the interest paid to the Trust Funds, $GINT^{SS}$.

References.

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Table B1: IGEM-Naics Industry Output and Inputs, 2010 (bil $)

	Industry Name	Output (prod	Input Energy	Material	Value-
1	Agriculture	378.8	27.0	187.1	164.7
2	Oil mining	94.4	10.5	25.9	58.0
3	Gas mining	129.7	14.1	35.0	80.6
4	Coal mining	32.9	4.4	10.3	18.2
5	Non-energy mining & support	155.3	8.7	75.4	71.2
6	Electric utilities (pvt+govt)	260.6	14.6	19.4	226.6
7	Natural gas distribution	115.0	60.1	16.4	38.6
8	Water and sewage	11.2	0.2	3.0	8.0
9	Construction	985.7	57.8	419.5	508.4
10	Wood and paper products	235.3	12.7	144.3	78.4
11	Nonmetallic mineral products	89.9	5.7	49.4	34.8
12	Primary metals	217.9	21.9	153.3	42.8
13	Fabricated metal products	275.7	3.7	152.6	119.4
14	Machinery	306.3	2.8	164.3	139.1
15	Information technology equip	231.0	0.7	67.1	163.2
16	Electrical equipment	259.3	1.6	112.3	145.4
17	Motor vehicles and parts	359.9	3.0	302.5	54.4
18	Other transportation equip	228.1	1.7	155.1	71.3
19	Miscellaneous manufacturing	211.4	1.3	92.5	117.6
20	Food, beverage and tobacco	773.3	17.1	577.4	178.8
21	Textile Apparel Leather	68.3	1.4	39.6	27.3
22	Printing and related activities	87.7	2.3	53.8	31.5
23	Petroleum and coal products	643.4	439.5	33.0	170.9
24	Chemicals, rubber and plastic	807.7	54.3	463.8	289.6
25	Wholesale Trade	1066.5	22.8	411.8	631.9
26	Retail Trade	1326.1	17.2	433.4	875.5
27	Transportation & warehousing	763.7	112.3	261.0	390.3
28	Publishing, Broadcasting, Telecom	841.5	6.3	385.4	449.8
29	Software, information tech svcs	599.8	2.2	275.1	322.5
30	Finance & Insurance	2305.3	6.8	1083.9	1214.6
31	Real Estate (ex OOH) and Leasing	1740.7	14.0	748.7	978.0
32	Business Services	2298.0	39.2	683.9	1574.9
33	Educational services (pvt+gov)	1240.1	40.6	381.5	818.1
34	Health care, social assist. (pvt+gov)	2091.7	22.6	766.3	1302.8
35	Accomodation and Other services	1480.9	26.9	613.4	840.7
36	Government (ex elect, health and educ)	1896.5	69.1	740.9	1086.5
	Household (owner-occ housing)	781.9	0.0	0.0	781.9

Table B.2a: 3-sector US Use table 2010 (bil $)

	Business Sectors			Final Demand					Total:
	Pri. Energy	Sec. Energy	Nonenergy	C	I	G	X	M	Commodity
Primary Energy	22.2	459.1	33.1	0.1	1.0	0.0	12.6	-284.8	243
Sec. Energy	6.8	55.1	570.8	427.5	-0.5	0.0	74.6	-83.8	1051
Nonenergy	71.1	68.8	9998.2	8052.4	2777.0	3002.8	1557.6	-1792.7	23735
Capital	122.7	337.9	4568.9	781.9					5811
Labor	34.1	98.1	8162.7						8295
Tax	9.8	28.8	381.6						420
Total: Industry output	267	1048	23715	9262	2777	3003	1645	-2161	
	Gross output =		25030		GDP =	14527			

Note: The definition of income and expenditures (GDP) is larger than the official definition due to the treatment of durables and methods of imputing rentals. "C" is consumption of nondurables and services; "I" includes consumer durables.

Table B.2b: 3-sector US Make (Supply) table 2010 (bil $)

	Business Sectors			Total:
	Pri. Energy	Sec. Energy	Nonenergy	Industry
Primary Energy	243.1	20.3	3.4	267
Sec. Energy	0.1	1013.5	34.3	1048
Nonenergy	0.2	16.8	23697.9	23715
Total: Commodity	243	1051	23735	

Table B3: Assignment of BEA's IO categories to IGEM 36 Industries

	IGEM-N Industries		BEA-65 industries	NAICS
1	Agriculture	1	Farms	111:112
		2	Forestry and related activities	113:115
2	Oil mining	3	Oil and gas extraction	2111 (Crude)
3	Gas mining	3	Oil and gas extraction	2111 (Gas)
4	Coal mining	4	Coal mining	2121
5	Non-energy mining & support	4	Mining except oil, gas, coal	212 (ex
6	Electric utilities (pvt+govt)	6	Utilities: Electric	2211
7	Natural gas distribution	6	Utilities: Natural gas	2212
8	Water and sewage	6	Utilities: Water, Sewage	2213
9	Construction	7	Construction	23
10	Wood and paper products	8, 22	Wood products; Paper Mfg.	321; 322
11	Nonmetallic mineral products	9	Nonmetallic mineral products	327
12	Primary metals	10	Primary metal mfg	331
11	Fabricated metal products	11	Fabricated metal product mfg	332
14	Machinery	12	Machinery	333
15	Information technology equipment	13	Computer and electronic prod	334
16	Electrical equipment	14	Electrical equip. & components	335
17	Motor vehicles and parts	15	Motor vehicle and parts mfg	3361:3363
18	Other transportation equipment	16	Other transportation equipment	3364:3369
19	Miscellaneous manufacturing	17	Furniture and related products	337
		18	Miscellaneous manufacturing	339
20	Food,beverage and tobacco products	19	Food, beverage and tobacco	311; 312
21	Textile, Apparel, Leather	20	Textile mills	313:314
		21	Apparel, leather and allied	315
22	Printing and related support activities	23	Printing and related activities	323
23	Petroleum and coal products	24	Petroleum and coal products	324
24	Chemicals, rubber, plastic	25	Chemical mfg	325
		26	Plastics and rubber products	326
25	Wholesale Trade	27	Wholesale Trade	
26	Retail Trade	28	Retail Trade	
27	Transportation & warehousing	29	Air transportation	481
		30	Rail transportation	482
		31	Water transportation	483
		32	Truck transportation	484
		33	Transit, ground psngr transp.	485
		34	Pipelines	486
		35	Other transportation	487,488,492
		36	Warehousing and storage	493
28	Publishing, Recording, Broadcasting and telecommunications	%37	Publishing (ex software)	511 (ex5112)
		38	Motion picture & sound	512
		39	Broadcasting and telecom	515; 517

29	Software and information technology services	%37	Software publishers	5112
		40	Information & data processing	518; 519
30	Finance & Insurance	41	Banks & credit intermediation	521:522
		42	Securities & investments	523
		43	Insurance	524
		44	Funds, trusts	525
31	Real Estate (rental); OOH intermediates: Leasing	%45	Real estate (ex owner-occupied)	531
		46	Rental and leasing	532:533
32	Business Services	47	Legal services	5411
		48	Computer systems design	5415
		49	Misc. professional, scientific	541 (ex5411,
		50	Management of companies	551
		51	Administrative services	561
		52	Waste management	562
33	Educational services (pvt + gov)	53	Educational services	61
34	Health care and social assistance (pvt+gov)	54	Ambulatory health care services	621
		55	Hospitals and nursing	622,623
		56	Social assistance	624
35	Accomodation and Other services	57	Performing arts, sports	711:712
		58	Amusements and recreation	713
		59	Accommodation	721
		60	Food services and drinking	722
		61	Other services except govt	81
36	Government (ex elec health edu)	62	Federal general government	92
		63	Federal government enterprises	92
		64	State & local general govt	92
		65	State & local govt enterprises	92
	Household capital	%45	Owner-occupied imputation	531

Table B4. Input structure of energy sectors and Consumption from the Use table, 2010 (mil $) (columns of the Use table)

		Oil	Gas	Coal	Electric	Gas	Petro.	Consu
1	Agriculture	0.00	0.00	0.00	0.00	0.00	0.01	68.4
2	Oil mining	7.84	0.00	0.00	0.00	0.00	367.39	0.0
3	Gas mining	0.00	10.52	0.00	6.17	59.67	19.33	0.0
4	Coal mining	0.25	0.34	3.24	6.43	0.00	0.13	0.1
5	Non-energy mining & support	1.71	2.34	1.37	0.00	0.00	0.08	3.5
6	Electric utilities (pvt+govt)	0.73	0.99	0.34	0.11	0.02	0.47	165.8
7	Natural gas distribution	0.62	0.85	0.32	0.03	0.24	1.84	56.6
8	Water and sewage	0.00	0.00	0.00	0.10	0.02	0.04	39.1
9	Construction	4.68	6.08	0.00	3.00	0.10	0.63	19.3
10	Wood and paper products	0.15	0.21	0.05	0.03	0.08	0.27	26.6
11	Nonmetallic mineral products	0.14	0.19	0.16	0.06	0.08	0.41	0.8
12	Primary metals	1.08	1.47	0.42	0.01	0.03	0.10	0.1
13	Fabricated metal products	1.66	2.27	0.54	0.82	0.40	0.59	2.4
14	Machinery	0.84	1.14	0.66	0.44	0.03	0.08	0.2
15	Information technology equip	0.00	0.00	0.01	0.04	0.13	0.29	0.0
16	Electrical equipment	0.01	0.01	0.04	0.10	0.38	0.14	6.1
17	Motor vehicles and parts	0.26	0.36	0.11	0.04	0.08	0.06	0.0
18	Other transportation equip	0.00	0.00	0.01	0.00	0.00	0.00	0.0
19	Miscellaneous manufacturing	0.06	0.08	0.01	0.01	0.02	0.01	30.7
20	Food, beverage and tobacco	0.00	0.00	0.00	0.08	0.00	0.03	463.4
21	Textile Apparel Leather	0.00	0.00	0.01	0.01	0.00	0.05	116.7
22	Printing and related activities	0.00	0.00	0.00	0.00	0.00	0.02	2.9
23	Petroleum and coal products	1.04	1.42	0.51	1.88	0.16	50.35	205.1
24	Chemicals, rubber and plastic	1.96	2.68	0.49	0.21	0.24	5.80	253.0
25	Wholesale Trade	0.85	1.16	0.58	0.31	0.28	12.36	361.4
26	Retail Trade	0.19	0.26	0.07	0.01	0.01	0.46	716.8
27	Transportation & warehousing	0.90	1.22	2.40	3.38	10.20	7.19	192.6
28	Publishing, broadcasting, telecom	0.14	0.19	0.02	0.07	0.05	0.06	277.9
29	Software, information tech svcs	1.78	2.42	0.42	0.34	0.28	0.18	64.7
30	Finance & Insurance	0.54	0.74	0.53	1.28	1.67	0.23	777.0
31	Real Estate (ex OOH) & leasing	2.93	3.98	0.78	0.25	0.24	0.46	871.8
32	Business Services	5.92	8.07	1.52	7.66	1.54	2.72	223.5
33	Educational services (pvt+gov)	0.00	0.00	0.00	0.09	0.04	0.00	301.4
34	Health, social assist. (pvt+gov)	0.00	0.00	0.00	0.00	0.00	0.00	1850.1
35	Accomodation and Other services	0.09	0.12	0.05	1.07	0.40	0.55	1309.5
36	Government (ex elec, health, educ)	0.00	0.00	0.00	0.03	0.04	0.15	72.4
	Capital	46.34	64.44	11.89	159.78	26.05	152.03	781.9
	Labor	11.66	16.15	6.33	66.77	12.54	18.83	0.0
	Tax	4.42	4.50	0.92	22.97	4.95	0.93	0.0
	Gross output	98.78	134.22	33.83	283.58	119.98	644.29	9261.8

Table B5. Energy inputs from the Use table (the energy commodity rows), 2010 (mil $)

		Oil	Gas	Coal	Electric	Gas	Petro.
1	Agriculture	0.00	0.00	0.20	2.98	1.35	22.46
2	Oil mining	7.84	0.00	0.25	0.73	0.62	1.04
3	Gas mining	0.00	10.52	0.34	0.99	0.85	1.42
4	Coal mining	0.00	0.00	3.24	0.34	0.32	0.51
5	Non-energy mining & support	0.00	0.00	0.68	1.79	2.64	3.55
6	Electric utilities (pvt+govt)	0.00	6.17	6.43	0.11	0.03	1.88
7	Natural gas distribution	0.00	59.67	0.00	0.02	0.24	0.16
8	Water and sewage	0.00	0.00	0.00	0.02	0.06	0.08
9	Construction	0.00	0.00	0.00	2.10	0.86	54.87
10	Wood and paper products	0.00	0.03	0.80	3.65	4.65	3.52
11	Nonmetallic mineral products	0.00	0.00	0.69	1.56	2.50	0.90
12	Primary metals	0.00	0.01	11.70	4.71	4.09	1.36
13	Fabricated metal products	0.00	0.01	0.01	1.79	1.39	0.52
14	Machinery	0.00	0.01	0.01	1.13	0.59	1.12
15	Information technology equip	0.00	0.00	0.00	0.45	0.13	0.10
16	Electrical equipment	0.00	0.00	0.01	0.67	0.32	0.64
17	Motor vehicles and parts	0.00	0.01	0.06	1.42	1.17	0.38
18	Other transportation equip	0.00	0.00	0.00	0.92	0.48	0.31
19	Miscellaneous manufacturing	0.00	0.00	0.00	0.68	0.33	0.32
20	Food, beverage and tobacco	0.00	0.02	1.35	5.94	7.26	2.52
21	Textile Apparel Leather	0.00	0.00	0.05	0.61	0.49	0.24
22	Printing and related activities	0.00	0.00	0.00	0.80	0.40	1.11
23	Petroleum and coal products	367.39	19.33	0.13	0.47	1.84	50.35
24	Chemicals, rubber and plastic	0.03	3.67	0.61	8.32	10.97	30.70
25	Wholesale Trade	0.00	0.27	0.02	4.26	1.58	16.72
26	Retail Trade	0.00	0.20	0.04	9.47	1.19	6.36
27	Transportation & warehousing	0.00	1.78	0.02	1.46	0.62	108.45
28	Publishing, broadcasting, telecom	0.00	0.17	0.02	1.67	1.66	2.81
29	Software, information tech svcs	0.00	0.01	0.00	0.74	0.07	1.40
30	Finance & Insurance	0.00	0.03	0.00	2.68	0.65	3.39
31	Real Estate (ex OOH) & leasing	0.00	0.09	0.18	8.08	0.92	4.68
32	Business Services	0.00	0.50	0.22	4.75	1.81	31.90
33	Educational services (pvt+gov)	0.00	0.01	0.10	5.57	8.00	26.87
34	Health, social assist. (pvt+gov)	0.00	0.22	0.11	8.96	2.30	10.97
35	Accommodation & other services	0.00	0.56	0.15	13.56	3.66	8.95
36	Government (ex elec, health, educ)	0.00	8.04	0.36	5.35	8.42	46.94
	Consumption	0.00	0.00	0.08	165.79	56.59	205.10
	Investment	0.24	0.78	-0.03	0.00	0.00	-0.50
	Government	0.00	0.00	0.01	0.00	0.00	0.00
	Exports	1.48	6.16	4.95	3.81	0.32	70.52
	Imports	-267.72	-17.84	0.80	-3.70	-0.55	-79.53
	Total Domestic Commodity	109.26	100.43	33.59	274.63	130.86	645.10

Table B6. The supply of energy commodities from the Make table, 2010 (mil $)

Commodity / Industry	Oil mining	Gas mining	Coal mining	Electric Utilities	Natural gas distr.	Petroleum Refining
Oil mining	38115	51357				8021
Gas mining	70987	48978				12290
Coal mining	21	26	33589			7
Electric utilities	4	6		268436	9691	
Natural gas distribution	23	31		6169	112485	
Petroleum refining						616703
All other industries	115	45		32	8687	8087
Total commodity	109264	100444	33589	274638	130863	645108

Table B7: Exports and Imports, Share of Commodity Output in 2010

Sector	Export Share	Import Share	Export ($bil)	Import ($bil)
Agriculture	0.125	0.115	46.8	43.1
Oil mining	0.014	2.450	1.5	267.7
Gas mining	0.061	0.178	6.2	17.8
Coal mining	0.147	0.000	4.9	0.0
Non-energy mining & support	0.053	0.006	8.5	0.9
Electric utilities (pvt+govt)	0.014	0.013	3.8	3.7
Natural gas distribution	0.002	0.004	0.3	0.5
Water and sewage	0.007	0.005	0.5	0.3
Construction	0.008	0.001	8.1	1.1
Wood and paper products	0.107	0.146	24.9	34.0
Nonmetallic mineral products	0.096	0.206	8.5	18.3
Primary metals	0.137	0.303	30.4	67.2
Fabricated metal products	0.101	0.167	27.4	45.2
Machinery	0.366	0.341	111.5	103.8
Information technology equip	0.351	0.903	77.6	199.5
Electrical equipment	0.236	0.630	56.6	151.5
Motor vehicles and parts	0.241	0.577	86.3	206.9
Other transportation equip	0.384	0.148	85.4	32.8
Miscellaneous manufacturing	0.186	0.538	38.3	110.7
Food, beverage and tobacco	0.073	0.092	58.9	73.5
Textile Apparel Leather	0.241	2.312	15.8	151.5
Printing and related activities	0.034	0.036	2.3	2.5
Petroleum and coal products	0.109	0.123	70.5	79.5
Chemicals, rubber and plastic	0.200	0.285	166.9	238.6
Wholesale Trade	0.117		142.7	
Retail Trade	0.013	0.005	16.0	6.5
Transportation & warehousing	0.140	0.047	111.4	37.2
Publishing, broadcasting, telecom	0.036	0.029	24.9	20.1
Software, information tech svcs	0.054	0.040	38.5	28.5
Finance & Insurance	0.040	0.040	91.5	90.5
Real Estate (ex OOH) and Leasing	0.055	0.009	101.6	16.9
Business Services	0.048	0.025	120.9	62.8
Educational services (pvt+gov)	0.005	0.003	6.0	3.4
Health care, social assist. (pvt+gov)	0.013	0.009	26.9	19.4
Accomodation and Other services	0.011	0.008	19.6	14.1
Government (ex elec, health, educ)	0.002	0.013	2.8	21.1

Table B8: Growth in Output, Inputs, and Prices, 1960-2010 (% per year)

		Output	Energy Input	Nonenergy Input	Relative Price
1	Agriculture	1.55	0.47	1.31	-0.77
2	Oil mining	-2.17	1.81	1.37	4.20
3	Gas mining	0.15	2.80	2.68	3.26
4	Coal mining	1.26	0.17	0.58	-0.19
5	Non-energy mining	1.78	1.25	2.50	0.76
6	Electric utilities (pvt+govt)	1.57	-1.38	-0.15	0.64
7	Natural gas distribution	0.04	1.04	1.37	1.92
8	Water and sewage	2.06	-1.88	4.41	2.03
9	Construction	1.04	1.64	1.51	0.93
10	Wood and paper products	1.41	1.05	1.67	-0.15
11	Nonmetallic mineral products	0.90	-0.32	1.41	-0.10
12	Primary metals	0.17	0.52	0.94	0.28
13	Fabricated metal products	1.37	-0.40	1.40	0.03
14	Machinery	2.75	-0.31	2.67	-0.89
15	Information technology equip	11.98	-1.36	4.92	-9.30
16	Electrical equipment	2.68	-0.74	2.60	-0.84
17	Motor vehicles and parts	1.85	-0.42	1.94	-0.89
18	Other transportation equip	1.81	-0.63	2.68	-0.03
19	Miscellaneous mfg	2.37	-0.37	1.68	-0.44
20	Food, beverage & tobacco	1.50	2.09	1.70	-0.19
21	Textile Apparel Leather	-0.95	-2.41	-1.88	-1.29
22	Printing	1.08	0.79	0.86	-0.33
23	Petroleum and coal products	1.50	1.90	0.41	2.12
24	Chemicals, rubber & plastic	2.64	2.26	2.98	0.05
25	Wholesale Trade	5.11	1.94	4.71	-2.22
26	Retail Trade	3.05	-1.48	2.30	-0.47
27	Transportation	2.67	2.52	2.45	-0.29
28	Publishing, B-casting, Telecom	4.47	0.00	4.42	-1.11
29	Software, information tech	11.29	4.30	9.86	-2.30
30	Finance & Insurance	4.75	1.05	5.02	0.23
31	Real Estate (ex OOH), Leasing	3.64	3.12	4.33	0.18
32	Business Services	4.07	1.27	4.77	0.83
33	Educational services	3.30	2.80	4.63	1.18
34	Health care, social assist.	3.66	2.10	5.33	1.47
35	Accomodation, Other svcs	2.54	1.23	3.07	0.55
36	Govt (ex elec, health, educ)	2.03	1.96	3.85	0.96

Note: Price growth is relative to the GDP deflator.

Table B9. Growth of industry output by subperiod (% per year)

		1947-2010	1947-1973	1973-1995	1995-2010
1	Agriculture	1.66	1.93	1.76	1.05
2	Oil mining	-0.55	4.20	-0.15	-9.37
3	Gas mining	-0.56	-0.60	-2.65	2.57
4	Coal mining	1.30	1.33	2.50	-0.52
5	Non-energy mining	1.50	0.55	0.84	4.11
6	Electric utilities (pvt+govt)	2.96	5.94	2.44	-1.43
7	Natural gas distribution	1.27	5.02	-3.00	1.02
8	Water and sewage	2.22	2.60	2.67	0.90
9	Construction	1.91	4.58	0.54	-0.70
10	Wood and paper products	1.53	3.23	1.53	-1.41
11	Nonmetallic mineral products	1.56	3.98	0.38	-0.90
12	Primary metals	0.31	2.39	-1.33	-0.88
13	Fabricated metal products	1.48	3.09	0.96	-0.55
14	Machinery	2.49	5.49	0.49	0.23
15	Information technology equip	11.21	8.58	14.80	10.50
16	Electrical equipment	3.23	5.66	2.10	0.68
17	Motor vehicles and parts	2.35	4.49	1.84	-0.59
18	Other transportation equip	2.95	5.38	0.82	1.85
19	Miscellaneous mfg	2.48	3.61	2.08	1.09
20	Food, beverage & tobacco	1.80	2.42	1.82	0.68
21	Textile Apparel Leather	-0.32	2.42	0.75	-6.63
22	Printing	2.31	3.86	3.03	-1.42
23	Petroleum and coal products	1.95	2.82	1.32	1.35
24	Chemicals, rubber & plastic	3.37	6.37	2.00	0.17
25	Wholesale Trade	4.83	5.44	4.62	4.07
26	Retail Trade	3.06	2.86	3.52	2.71
27	Transportation	2.26	2.62	2.68	1.03
28	Publishing, broadcasting, telecom	4.52	5.42	4.15	3.50
29	Software, information tech	9.86	5.46	15.60	9.06
30	Finance & Insurance	4.75	4.27	5.28	4.81
31	Real Estate (ex OOH), Leasing	3.75	4.43	3.27	3.27
32	Business Services	4.16	5.22	3.79	2.85
33	Educational services	3.68	5.55	2.81	1.71
34	Health care, social assist.	3.63	4.36	3.29	2.86
35	Accomodation, Other svcs	2.19	1.97	2.91	1.52
36	Government (ex elec, health, educ)	2.11	2.77	1.52	1.82

Table B10. Output of Energy industries (producer'sprices, billion $2005)

	Oil	Gas	Coal	Electric	Gas	Petroleum
1960	19.40	35.11	2.32	20.35	21.73	40.37
1961	20.13	36.34	2.35	20.72	22.23	40.04
1962	21.04	36.94	2.37	22.18	23.55	41.41
1963	21.88	38.49	2.41	23.05	24.43	43.52
1964	22.67	40.44	2.51	24.80	26.26	47.31
1965	24.34	43.26	2.79	26.54	27.50	48.27
1966	26.94	46.24	2.99	28.10	28.95	51.40
1967	29.71	50.67	2.97	31.91	32.83	56.35
1968	31.95	53.00	3.20	34.27	35.68	62.11
1969	34.20	59.01	3.47	35.78	36.80	66.93
1970	37.08	62.52	3.84	39.73	39.63	69.11
1971	38.09	65.46	3.74	42.19	40.88	72.99
1972	39.76	66.27	3.91	41.82	53.61	78.27
1973	41.61	69.26	4.11	47.18	54.74	78.56
1974	40.49	81.50	4.57	52.92	58.31	92.40
1975	45.80	72.56	5.38	60.28	60.94	103.38
1976	49.98	69.64	5.96	67.55	64.02	120.94
1977	59.07	63.76	6.45	76.26	68.35	137.21
1978	67.34	65.55	6.61	84.99	76.14	142.50
1979	70.82	74.98	8.33	97.78	89.26	161.04
1980	66.71	84.60	9.65	110.01	99.73	173.38
1981	64.79	91.50	10.48	124.01	110.97	166.47
1982	78.23	83.32	11.22	130.80	112.11	173.51
1983	85.30	79.48	10.90	141.86	102.91	171.07
1984	94.52	86.16	12.95	151.28	105.29	199.93
1985	97.71	87.84	13.13	157.10	100.32	199.45
1986	116.29	69.81	13.58	160.41	88.62	198.37
1987	102.60	90.96	14.42	170.96	84.96	228.59
1988	115.85	81.99	15.42	184.83	90.56	247.26
1989	105.17	97.14	16.51	193.51	91.35	251.51
1990	99.37	116.93	17.99	204.09	87.39	259.54
1991	109.38	110.07	18.01	208.37	87.26	270.20
1992	114.85	104.58	18.46	209.82	91.90	270.49
1993	131.37	85.08	17.83	220.21	94.74	276.97
1994	134.47	87.49	19.92	229.90	84.34	290.81
1995	117.23	112.65	20.26	238.59	83.08	304.49
1996	125.37	106.15	21.09	241.00	85.30	316.37
1997	137.06	96.65	22.33	249.30	79.37	333.36
1998	159.82	71.85	22.48	247.95	89.63	335.32
1999	127.36	89.38	21.73	299.67	98.17	350.05
2000	120.39	89.93	21.06	333.25	115.04	356.48
2001	146.99	70.63	21.88	380.53	117.98	368.44
2002	127.15	100.84	21.60	265.40	123.78	386.37
2003	133.23	83.09	21.30	240.90	129.37	373.59
2004	110.74	104.31	22.68	231.92	133.84	416.65

2005	97.50	114.19	23.81	247.23	146.88	455.49
2006	41.82	143.36	25.25	243.70	138.31	464.30
2007	42.08	157.13	25.59	259.14	148.11	490.66
2008	40.18	165.31	26.85	272.70	162.77	480.43
2009	38.48	209.23	24.90	246.74	125.63	445.87
2010	37.46	218.62	25.40	246.38	128.53	509.60

Table B11. Industry output price of energy industries.

	Oil	Gas	Coal	Electric	Gas	Petroleum
1960	0.308	0.116	1.423	0.770	0.342	0.438
1961	0.306	0.116	1.394	0.770	0.348	0.434
1962	0.303	0.117	1.378	0.762	0.347	0.422
1963	0.298	0.115	1.367	0.763	0.342	0.414
1964	0.293	0.111	1.432	0.755	0.333	0.390
1965	0.286	0.109	1.380	0.745	0.330	0.398
1966	0.280	0.110	1.356	0.728	0.320	0.401
1967	0.275	0.109	1.328	0.710	0.312	0.397
1968	0.266	0.108	1.326	0.695	0.299	0.371
1969	0.266	0.104	1.345	0.678	0.291	0.356
1970	0.260	0.104	1.449	0.677	0.288	0.345
1971	0.264	0.104	1.432	0.698	0.293	0.347
1972	0.253	0.103	1.439	0.704	0.299	0.338
1973	0.275	0.112	1.517	0.704	0.305	0.410
1974	0.445	0.150	2.565	0.778	0.337	0.589
1975	0.454	0.194	2.867	0.822	0.406	0.620
1976	0.459	0.223	2.736	0.841	0.475	0.627
1977	0.451	0.283	2.626	0.868	0.548	0.654
1978	0.443	0.307	2.696	0.874	0.565	0.649
1979	0.574	0.366	2.703	0.870	0.611	0.810
1980	0.898	0.465	2.566	0.928	0.702	1.115
1981	1.209	0.550	2.517	0.971	0.754	1.202
1982	1.023	0.625	2.447	1.005	0.844	1.074
1983	0.903	0.639	2.243	0.997	0.927	0.947
1984	0.860	0.624	2.133	1.016	0.891	0.882
1985	0.777	0.574	2.038	1.023	0.842	0.823
1986	0.395	0.441	1.883	1.017	0.738	0.546
1987	0.473	0.358	1.776	0.990	0.664	0.561
1988	0.373	0.354	1.641	0.977	0.632	0.521
1989	0.453	0.330	1.565	0.969	0.630	0.560
1990	0.551	0.315	1.503	0.955	0.618	0.651
1991	0.440	0.294	1.434	0.973	0.598	0.571
1992	0.415	0.307	1.371	0.972	0.587	0.540
1993	0.362	0.376	1.264	0.971	0.600	0.510
1994	0.328	0.339	1.211	0.953	0.613	0.482
1995	0.356	0.249	1.165	0.954	0.577	0.488
1996	0.441	0.351	1.126	0.948	0.607	0.542
1997	0.405	0.386	1.073	0.934	0.644	0.521
1998	0.253	0.371	1.029	0.913	0.579	0.400

1999	0.356	0.336	0.966	0.884	0.569	0.451
2000	0.599	0.531	0.934	0.895	0.698	0.644
2001	0.479	0.658	0.964	0.938	0.809	0.585
2002	0.486	0.406	0.966	0.918	0.651	0.547
2003	0.582	0.763	0.951	0.943	0.824	0.650
2004	0.756	0.791	0.978	0.946	0.886	0.768
2005	1.000	1.000	1.000	1.000	1.000	1.000
2006	2.164	0.867	1.013	1.033	0.998	1.137
2007	2.344	0.864	1.021	1.034	0.970	1.216
2008	3.241	1.088	1.220	1.082	1.043	1.507
2009	1.922	0.486	1.261	1.042	0.898	1.054
2010	2.519	0.593	1.295	1.058	0.895	1.262

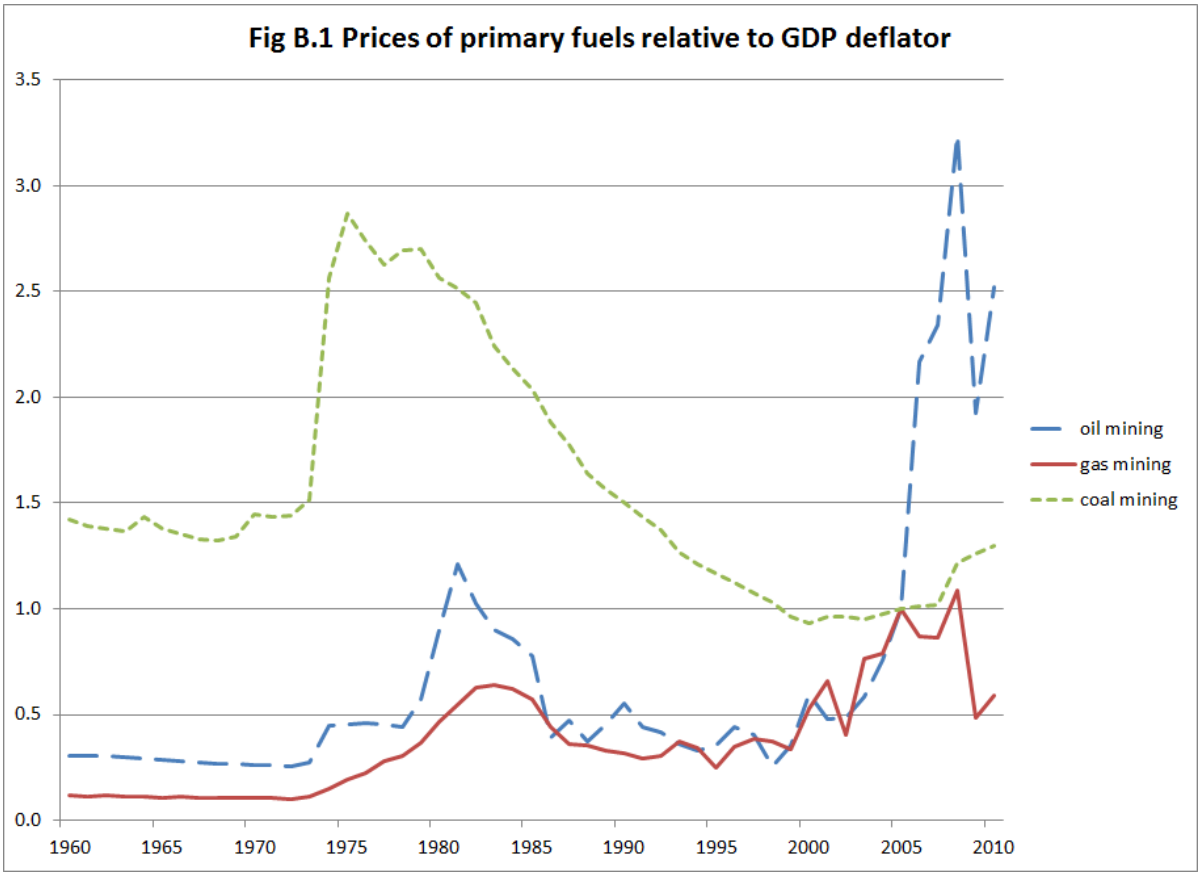


Fig B.1 Prices of primary fuels relative to GDP deflator
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
oil mining
gas mining
coal mining

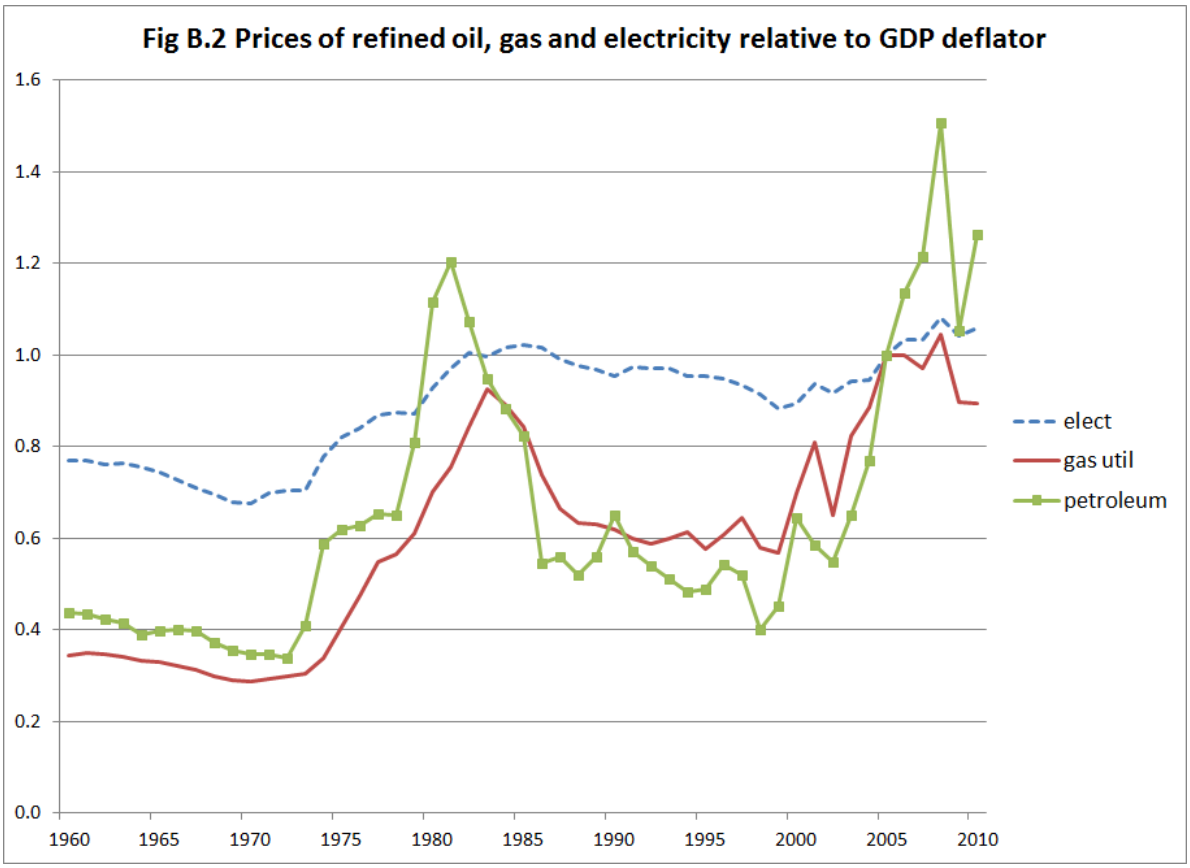


Fig B.2 Prices of refined oil, gas and electricity relative to GDP deflator
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
elect
gas util
petroleum

Fig. B3. Value-added share of output, 2010

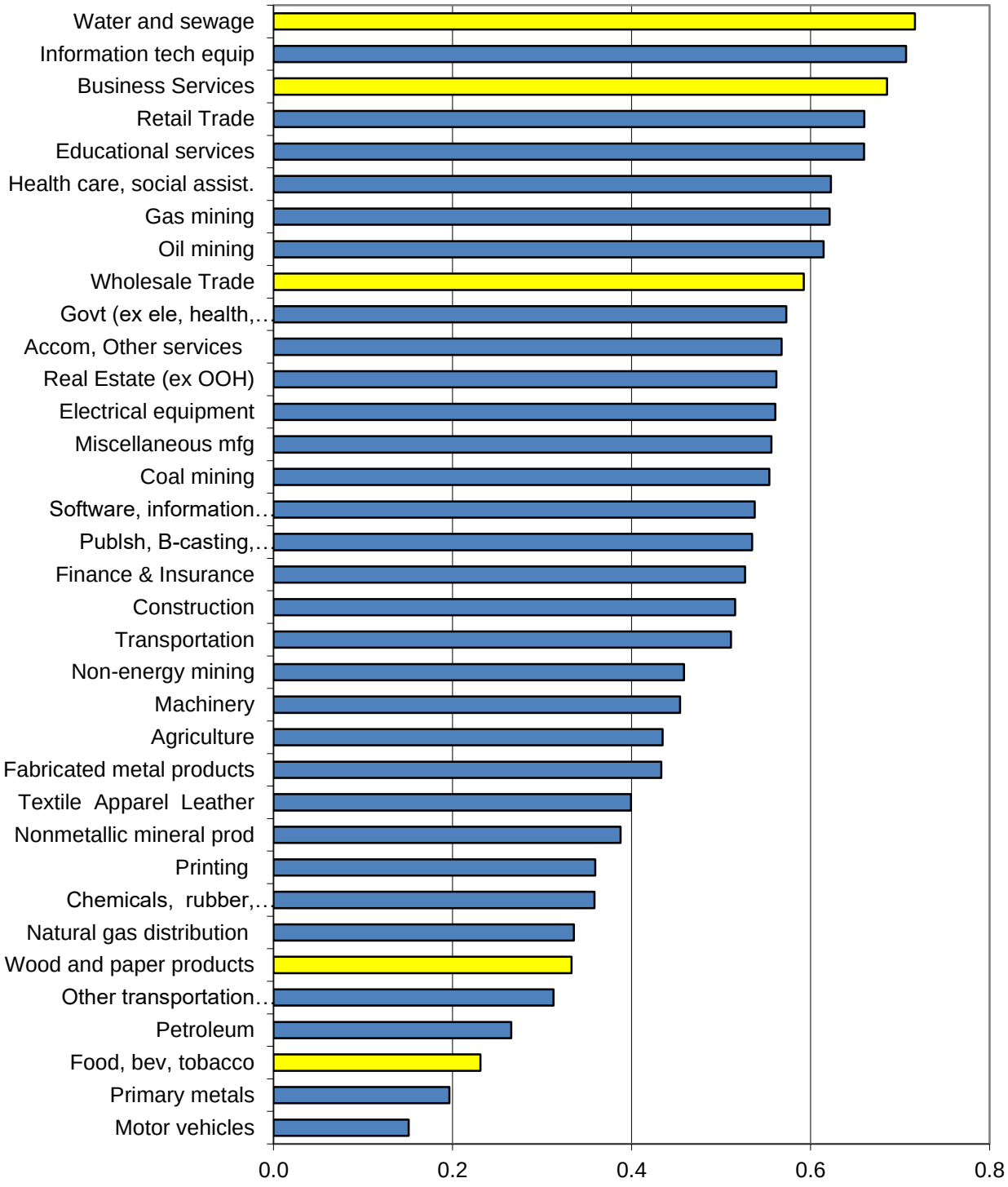
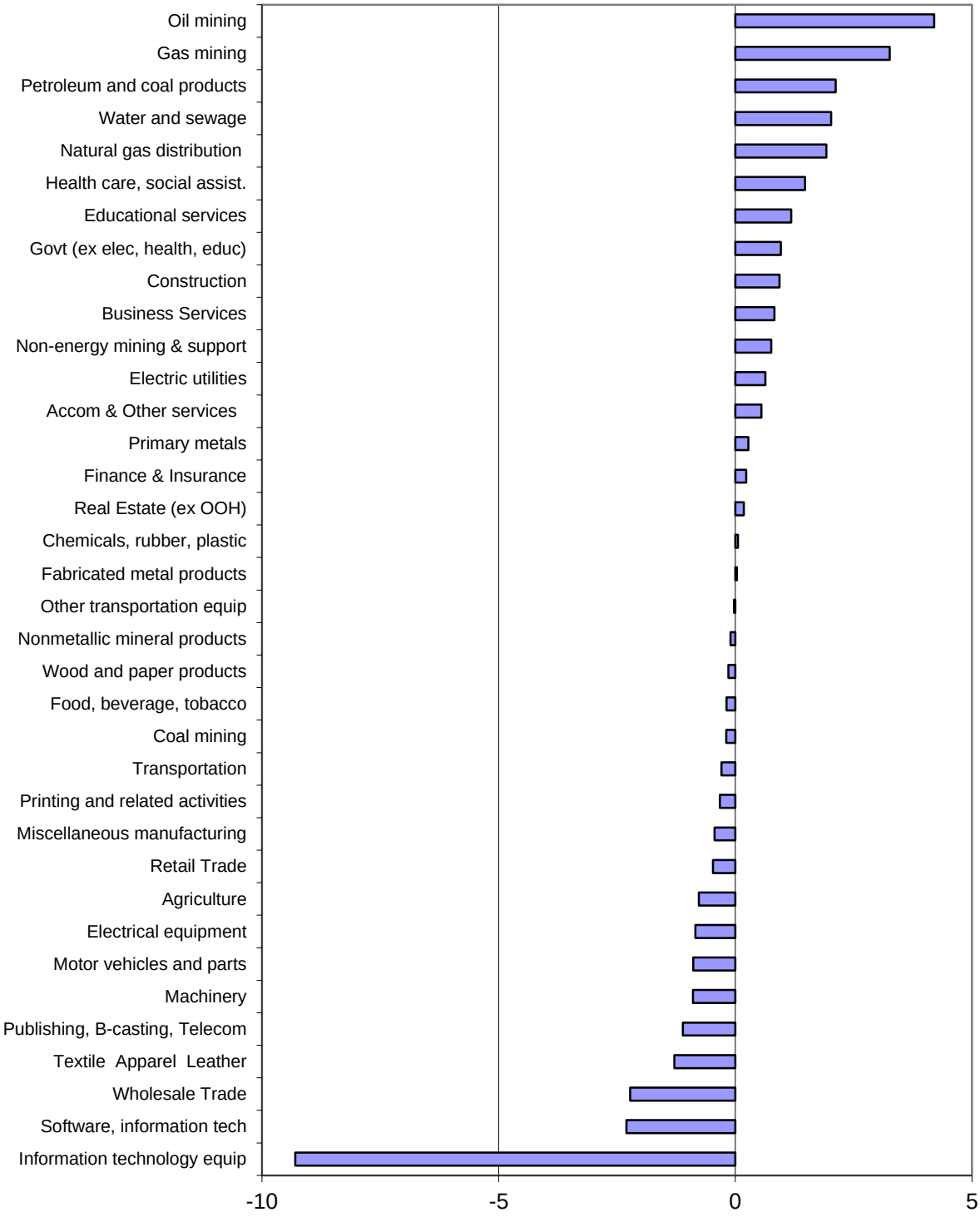


Fig. B4: Growth Rate of Industry Price relative to GDP deflator 1960-2010



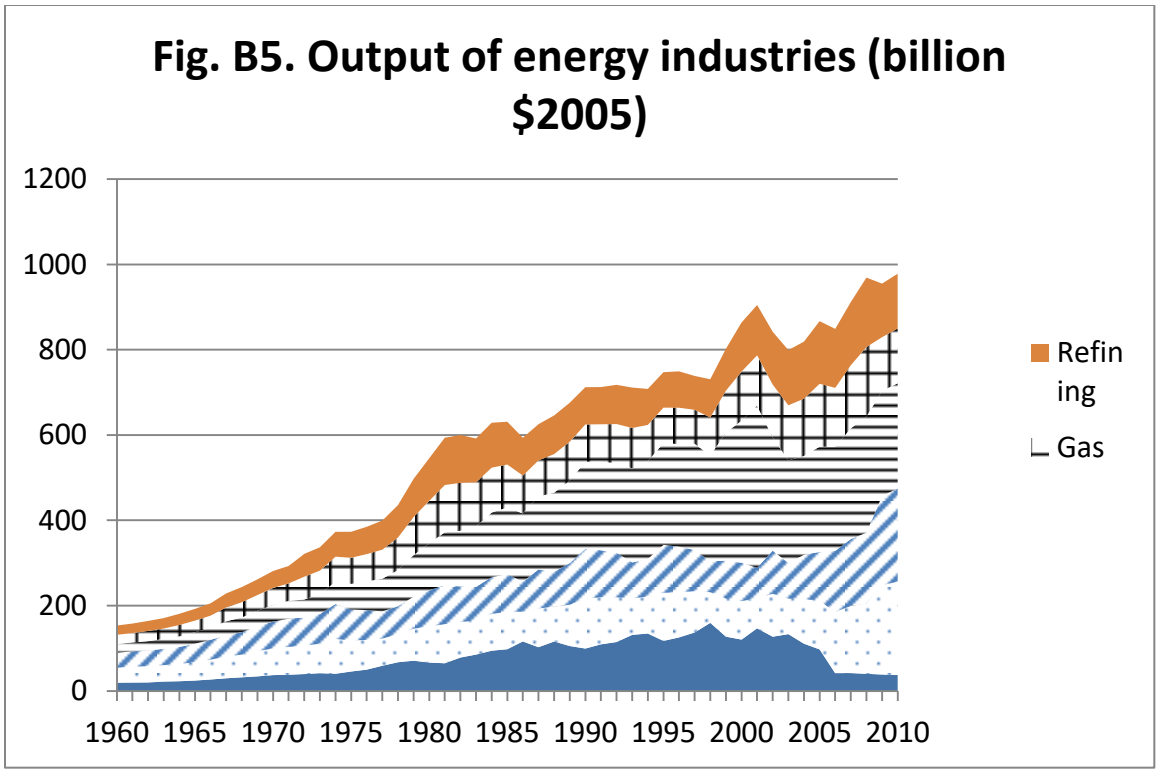


Fig. B5. Output of energy industries (billion $2005)
1200
1000
800
600
400
200
0
1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010
Refining
Gas