Measuring the Macro Economy

What We Already Know

As we've seen, macroeconomics is the study of aggregates; the study of how the entire economy works. It is a daunting and complex enterprise, but one that is essential for the smooth operation of a nation's long-run economic well-being. We saw that the most important macroeconomic policy goals are strong, steady per capita output growth, with low and stable inflation and unemployment rates. Although you probably have some idea what each of these are, their actual definition and estimation is a complicated matter. Before looking into modeling output, unemployment and inflation, we must first know what each of these is.

This chapter outlines the manner in which the most important macroeconomic estimates are calculated. Perhaps no measure is so widely talked about as the Gross Domestic Product. We therefore start with descriptions of the measures of output, focusing on both nominal and real measurements of the nation's output and income. We next take up the issue of inflation. How many times have you heard estimates of the inflation rate, yet think for a minute about how those estimates are produced. Measuring the change in prices throughout the entire economy seems almost impossible, yet so much, from estimates of the poverty rate, to labor contracts to government spending, all depend upon inflation estimates and on our expectations of future inflation rates. The chapter then turns to the tabulation and consequences of the unemployment rate, and concludes with short descriptions of interest rates, exchange rates and leading indicator indexes.

Overview of the Chapter

- The basic measurement of the overall value of final goods and services for the economy is the Gross Domestic Product. (GDP)
- The GDP is the output approach to the measurement of total economic activity, while National Income (NY) is the income approach to its measurement.
- Disposable Income is the amount households have either to spend or save.
- When comparing values over time, it is essential that *real* values be used rather than *nominal ones*.
- In order to account for changes over time, we generally use either Laspeyres or Paasche indexes.
- The Implicit GDP Price Deflator is a Paasche index for estimating inflation. It is the ratio of nominal GDP to real GDP.
- The Consumer Price Index is a Lasperyres Index. It values a given bundle of goods at base year prices and current year prices in order to estimate the increase in prices over the period.
- The Unemployment Rate is measured as the proportion of people unemployed (laid off, waiting to start a new job or seeking employment and unable to find it) in the labor force (the sum of those working and of the unemployed)
- A simple, stable relationship exists between output and unemployment, known as Okun's Law. Okun's Law states that for every 2 percent fall in unemployment, output increases by 1 percent.
- We make a distinction between the "nominal" and "real" interest rates. The nominal interest rate minus the inflation rate is an approximation for the real interest rate.
- The term structure of interest rates is the relationship of interest rates to the length of the loans.
- The nominal exchange rate is the amount by which one currency trades for another. The real exchange rate is the nominal exchange rate adjusted for the relative price levels in the two countries.
- Purchasing power parity is the law of one price applied to exchange rates.

Key Terms

Gross Domestic Product
Final goods and Value Added
National Income
Disposable Income
Real vs. Nominal
Indexes
Paasche and Laspeyres Indexes
Labor Force
Unemployment Rate
Discouraged Workers
Consumer Price Index
Implicit GDP Price Deflator
Chain-weighted GDP Price Deflator
Okun's Law
Nominal and Real Interst Rates
Nominal and Real Exchange Rates

Gross Domestic Product: Output Approach

Estimating overall economic activity is an awesome job. In the United States, the Bureau of Economic Analysis (BEA) within the Commerce Department produces the National Income and Product Accounts. (NIPA) These accounts provide the data by which we can judge the production and income of the entire economy. The most important aggregate that gives the fullest indication of the production of the economy is the Gross Domestic Product (GDP). This is the value of the final goods and services produced in the country over a given period. Let's look at how we come up with this figure.

First, note that we cannot simply add up all new products. We have to be able to value them; we can do this because we see the purchase and sales of items in the economy. If we add together the purchases of new, final goods and then take into account any change in the value of inventories of unsold goods, we have an estimate of the value of total

production. We are going to include only those legal, market transactions involving new, final goods.

Note that we keep using the term "final goods." We cannot count all market transactions since many goods are sold as intermediary products in the production of another good. Take, for example, this book that you are so eagerly reading. The paper was milled and sold to the publisher along with all the other materials that went into producing the book. If we counted the value of each of these inputs along with the price you paid for the book, we would be double-counting. Either, we add up all the additions to the value of the product at each stage of production, the so-called **value added**, or we simply count the value of the final good produced. Taking the value added approach to calculating total economic activity would be far more difficult since each item sold as a final product would involve many, sometimes hundreds of stages, each with its own incremental value added.

Noting now the distinction between "goods" and "final goods," let's just look at final goods, and divide up the transactions in the economy among personal consumption expenditures, purchases for investment, government purchases and foreign trade. Remember that we only want to include the value of transactions concerning goods and services, not all payments. Let's look at simple purchases first. We will talk about household consumption throughout the book simply as "consumption," and denote it with the variable *C*. Consumption is the sum of the value of durable purchases, non-durables and services. Turning to investment, denoted *I* throughout the text, we see that is composed of large fixed assests for investment (further divided into residential and non-residential), and changes in inventories for future consumption. (we don't want to include old stocks of inventories since we are only interested in calculating current production). Even in market economies, the Government is a relatively large consumer of goods and services and an investor in capital

goods. In the national product accounts, we separate government into a separate category. Note, though, that we are only including here government purchases of goods and services, and payments for public goods, and not all government payments, many of which are simply transfers back to the public. Finally, we must note that some of our production goes abroad in the form of exports and that some of what we consume was actually produced elsewhere, viz., that of what we import. We only want to include what we produce, so we add exports (X) and subtract imports (M), giving us the difference which we call net exports (NX).

Putting this together, we have:

$GDP = C + I + G + (X-M) = C + I + G + NX.$[1]

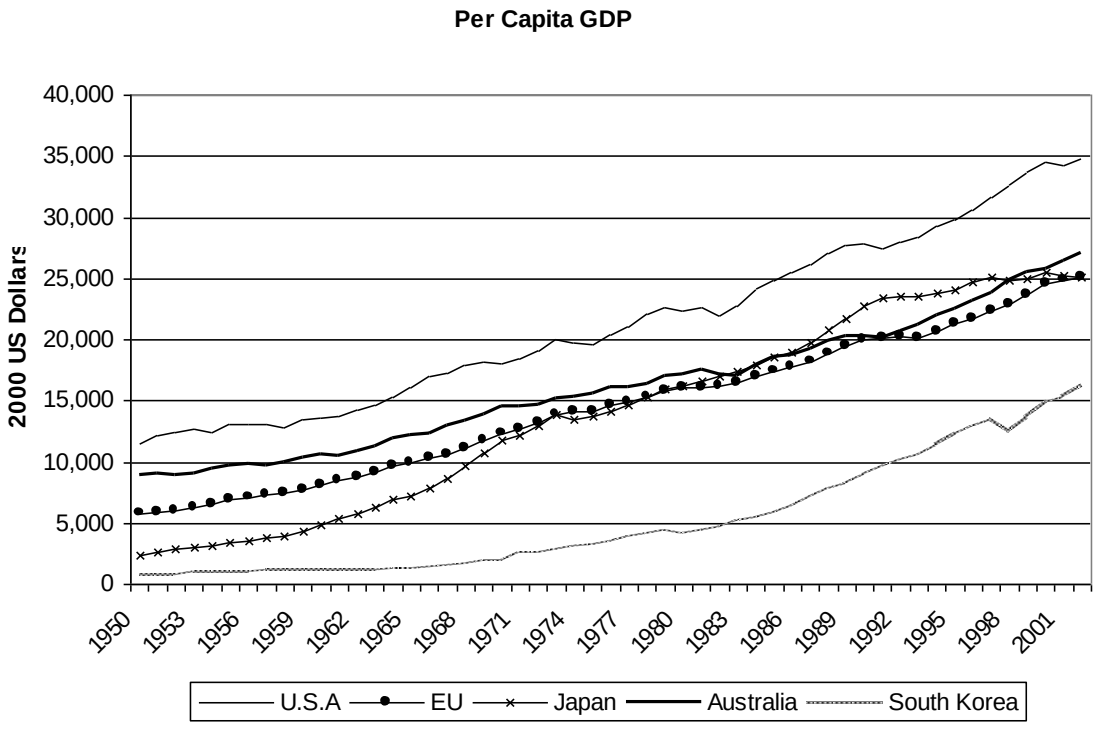
Table 2.1 below shows the decennial values, 1960-2000 along with 2002, for the components of nominal US GDP. Each of the components of GDP is there, consumption, investment, government and net exports. Note that in each of the years consumption plays the major role in GDP, averaging about 2/3 of GDP over the period and was 70.3 percent of GDP in 2002. Note, too, that within consumption, services make up a larger and larger proportion of spending. As economies mature, more and more spending is devoted to services like banking, insurance, etc. In the investment category, you can see that fixed investment plays, by far, the most important role, but in our models changes in inventories will be important also, as we think about notions of "equilibrium" income. Although government spending is large, in 2002 it made up only about 18 percent of domestic spending. By "government," we mean all public spending on goods and services, so we include federal, state and local purchases. Actually, over 60 percent of "Government" spending is accounted for by state and local governments; Federal spending alone was only about 6 percent of the GDP. This stands in sharp contrast to other industrial nations.

Table 2.1: Components of Nominal US GDP
(Billions of US Dollars)

	Consumption (C)			Investment (I)			Gov't (G)	Net Exports (NX)			Gross Domestic Product (GDP)
	Durables/ Non-Durables	Services	Total	Fixed	Change in Inventories	Total	Total	Exports	Imports	Net	
1960	196.1	135.6	331.7	75.7	3.2	78.9	111.6	27.0	22.8	4.2	526.4
1970	375.0	291.5	648.5	150.4	2.0	152.4	233.8	59.7	55.8	4.0	1,038.5
1980	970.3	846.9	1,757.1	485.6	- 6.3	479.3	566.2	280.8	293.8	- 13.1	2,789.5
1990	1,724.1	2,115.9	3,839.9	846.4	14.5	861.0	1,180.2	552.4	630.3	- 78.0	5,803.1
2000	2,810.5	3,928.8	6,739.4	1,679.0	56.5	1,735.5	1,721.6	1,096.3	1,475.8	-379.5	9,817.0
2002	2,997.3	4,388.0	7,385.3	1,589.2	5.4	1,589.2	1,932.5	1,006.8	1,423.1	-426.3	10,480.8

Source: Table B-1, *Economic Report of the President 2004*.

Figure 2.1:



Source: OECD Data.

Figure 2.1 shows the per capita GDP figures for the US and the European Union (EU), Japan, Australia and South Korea. Two things are very interesting about this figure. The first is that the levels of per capita income are quite different. What determines these differences? The second is that over the 50- year period, the rates of change of per capita GDP are very different, too. What determines these differential growth rates? By the end of the text, we hope that you will some answers to these important questions.

Measuring the Unmeasurable

Many factors that affect our lives are not directly seen in the economy and allowances have to be made for those. One such issue is housing. When someone builds a house, it is residential investment, but the housing "produces" something over time. By living in the house, the owners do not pay rent directly but are receiving the services of living in a dwelling. In order to account for this the National Income Accounts impute rent prices and add them to the GDP. These imputed rent amounts are added to the consumption of services.[1]

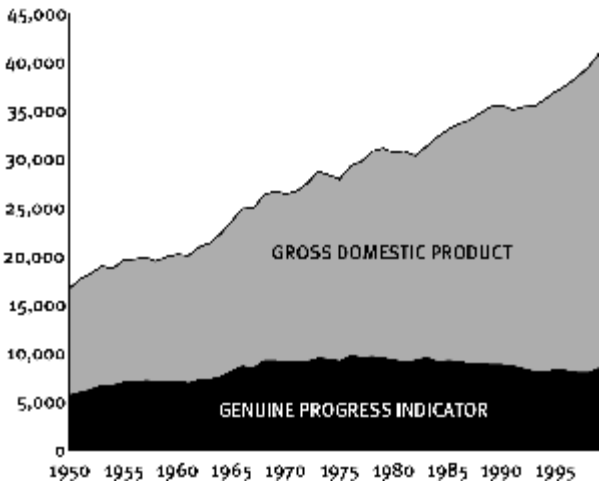
Although the GDP does a good job of providing us with an indication of the overall activity of the economy, it does not include many factors that affect economic well-being, either positively and negatively. For example, much of the "work" done in the economy is unpaid. Housework, for example, and much child-care is not directly paid and so is not included in the GDP. If child care is paid for, it is included; when there is no market transaction, it is not included. Nancy Folbre has estimated that the costs of raising a child adding imputed child care costs yields a value about four times as great as cash expenditures alone.[2] The same goes for food preparation and care for elderly parents. (Note that much of

this work has fallen traditionally to women, so their role in the economy has been underestimated for a long time) Over time, as more and more services, e.g. going out to restaurants, hiring nurse aids, etc., are purchased the GDP rises, but much of what is now measured as being "produced" was produced in the past. This factor tends to overstate the growth in "output."

In addition, it might be that while gross output is rising, pollution, crime and overall social dislocation might also be increasing. Remember that we are so concerned about per capita GDP because it gives us some sense in well being. Many factors, besides merely goods and services, though, determine "well being." These other factors are especially important factors in developing nations, as income might be rising but the quality of life for very many might actually be falling. In order to address these factors, several alternative measures of economic activity are also calculated. Redefining Progress of San Francisco produces one of these measures. Each year they attempt to estimate a "Genuine Progress Indicator" that "starts with the same accounting framework as the GDP, but then makes some crucial distinctions: It adds in the economic contributions of household and volunteer work, but subtracts factors such as crime, pollution, and family breakdown."[3] In Figure 2.2, the GPI is compared to the GDP for 1950-1999.

Figure 2.2:

Genuine Progress Indicator vs The Gross Domestic Product
(constant 1966 Dollars)



Source: Redefining Progress, http://www.rprogress.org/projects/gpi/

Another alternative measure of economic well-being was produced by Marc Miringoff and Marque-Luisa Miringoff. Each year they calculated a series of indexes, that they combined into an overall index to track the changes in factors such as teen pregnancy, violent crime, well-being of America's children and youth, the accessibility of health care, the quality of education, or the adequacy of housing. Whether these indexes were rising or falling gives indications of how the well being of people in the economy are doing. All the individual indexes were combined to calculate an overall Health Index of the US. This index fell to a low of 38 in 1993 (1965-70 = 100:CHECK THIS), from a high of 77 in 1973, even though, as we have seen, per capita income growth was strong over the 1980s. In 2001, the index was at 46.

National Income: The Income Approach

Table 2.1 above provides the data for the output method of measuring economic activity. We know, though, that since we have the values of the outputs, we can also add up all the payments to the economic factors (land, labor, capital) that were involved in producing the output. By adding up the total payments to factors, we are taking the income approach to valuing total activity. Given this symmetry, throughout the book we will be using total output (GDP) and total, or national income (NY) interchangeably. In order to do this, though, we do need to understand the formal relationship between the GDP and national income.

We will have to make some adjustments to the GDP since not all its value goes to factors. The Gross Domestic Product includes all sales within the domestic economy, no matter who makes them. If a foreign company, say Toyota, produces cars in the US, those cars are counted toward the US GDP. In contrast, the Gross National Product, only includes the production of nationals, no matter where they are, in the total value. So, for example, Ford Europe would be counted in the GNP but not in the GDP. Likewise, Toyota in the US would not be included in the GNP but would form part of the GDP. Given the large degree of globalization over the past twenty years, most international figures for comparison are measured in the GDP; foreign direct investment has very large effects on labor markets and outputs in most industrial and newly industrial countries.[4]

If we take the GNP and subtract out all the payments that go to keeping fixed capital at its present value, that is the monies paid out for depreciation, we are left with **Net National Product** (NNP). Taking the NNP and subtracting out the charges incurred for transactions, mainly things like sales taxes – what the income accounts calls "indirect

business taxes" – we are left with the total payments that should go to all the factors that produced all the goods: **National Income** (NY).

Computing the National Income from the GDP should yield the same amount as directly adding up all payments to the economic factors. The value of National Income estimated directly is:

NY = (Wages and Salaries) + (Rental Income) + (Net Interest) + (Corporate Profits) + (Proprietor's Income)

As you can see, the sum is of payments to workers, to the owners of land, and to corporations and small businesses. In fact, in 2002 the difference between the two methods, the output and income approach, was only 0.8 percent; this difference between the two approaches is known as the "statistical discrepancy." Throughout the book, we will be ignoring the distinction between NY and the GDP and speaking of output and income interchangeably.

Personal and Disposable Income

We will, however, be dealing often with the amount of income households have to either spend or save, what we call **Disposable Income**. (DY) We derive disposable income from national income. We must remove those factors that are not received by households and add other factors that are not included in NY but do go to households. First, we net out the profits of corporations that are not paid out in dividends, so-called "undistributed corporate profits."[5] We then we add net government transfers, business transfers and interest payments to households. We then have what is known as **Personal Income**. Subtracting out income taxes from Personal Income and we have **Disposable Income**. This is the amount that households actually have to spend or save.

Fast Facts

The Gross Domestic Product (GDP) is the output approach to measuring the value of final goods and services produced. It is:

GDP = C + I + G + NX.

The National Income (NY) also measures the total economic activity, but form the income side.

The National Income is:

NY = Wages and Salaries + Rental Income + Interest + Corporate Profits + Proprietor's Income

Since both approaches are essentially measuring the same thing, we can derive one from the other:

GDP – Depreciation = Net Domestic Product (NDP)

NDP – Indirect Business Taxes = NY

That part of National Income that goes to households is the Disposable Income. Essentially, we get to disposable income through Personal Income.

NY – undistributed corporate profits + net Gov't Transfers +/- (other factors) = Personal Income (PY)

PY – Individual Income Taxes = Disposable Income (DY)

Real vs. Nominal Values

Table 2.1 provided the value of each of the categories in current prices. -- that is, the values are given in the prices of the year tabulated. These values are meaningful in each of the years, but if we want to compare output levels in different years, we have a problem. Suppose we want to know how much more output was in 2002 compared with 1960. Using

the table it would seem that output grew about 20 fold, at an average of about 7 percent per year. At that rate of growth, the US would have achieved almost double its long-run growth rate. But think about what these numbers are: they are the sums of the products of both prices and quantities. If prices were increasing, then overall values would be rising, even though outputs might be not changing at all. How can we account for this problem?

The answer, as you probably well know, is by computing *real* values for the GDP figures. We control for the price changes and can focus more simply on the quantity changes themselves. Table 2.2 provides the data in Table 2.1 but with real values instead of nominal ones.

Table 2.2: Components of Real US GDP
(Billions of Chained (2000) US Dollars)

	Consumption			Investment			Gov't	Net Exports			Gross Domestic Product (GDP)
	Durables/ Non-Durables	Services	Total	Fixed	Change in Inventories	Total	Total	Exports	Imports	Net	
1960	-----	-----	1,554.6	-----	-----	266.6	715.4	27.0	22.8	4.2	2,501.8
1970	-----	-----	2,451.9	-----	-----	-----	1,012.9	161.4	213.4	-52.0	3,771.9
1980	-----	-----	3,374.1	-----	-----	-----	1,115.4	323.5	310.9	12.9	5,161.7
1990	1,937.5	2,851.7	4,770.3	895.1	15.4	895.1	1,530.0	552.5	607.1	-54.7	7,112.5
2000	2,810.5	3,928.8	6,739.4	1,679.0	56.5	1,735.5	1,721.6	1,096.3	1,475.8	-379.5	9,817.0
2002	3,000.8	4,141.8	7,140.4	1,565.8	5.7	1,572.0	1,836.9	1,014.2	1,484.7	-470.6	10,083.0

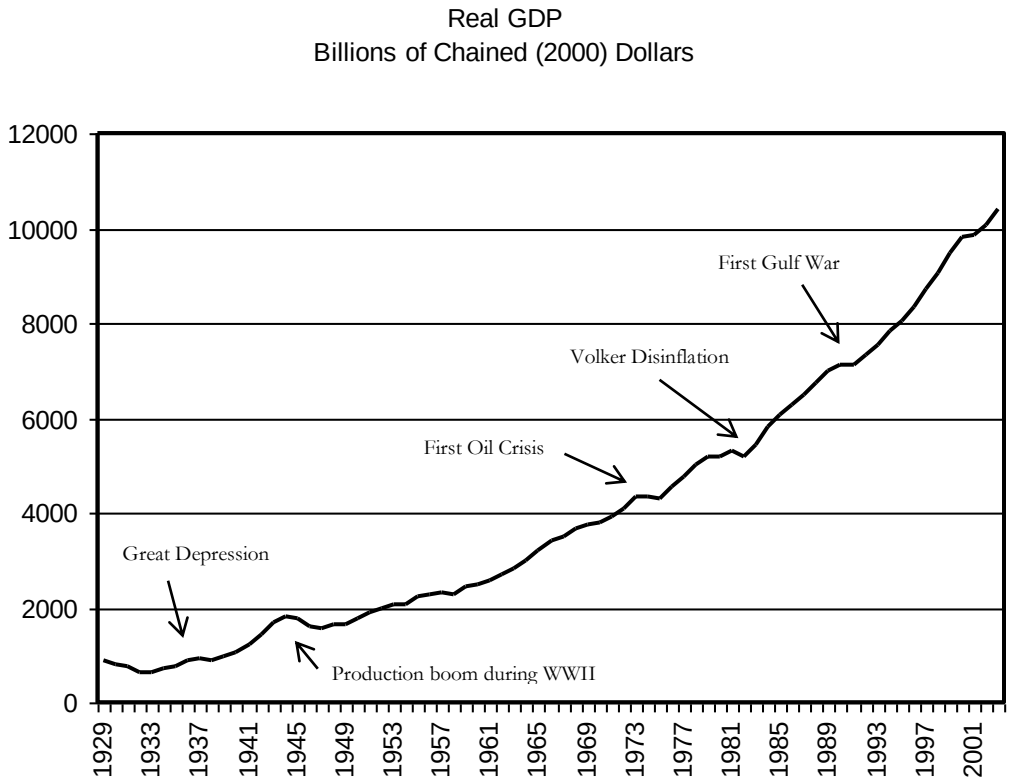
Source: Table B-2, *Economic Report of the President 2004*.

Using the real values from Table 2.2, we see that the GDP went up, not twenty fold, but only four fold. Clearly, prices had been increasing along with the output. Whereas the proportions of the components are virtually the same (in 2002 the real values show that consumption was 70.4 percent of GDP, for example), the levels are different. Accounting for the on-going increases in prices means that we have to value outputs of the (distant) past

of 1960 higher and lower the values of 2002. As the tables show, accounting for these price changes make very large differences and should always be considered when making comparisons over time.

Figure 2.3 provides estimates of the real GDP from 1929-2003 and chronicles the economic history of the US economy over the last seventy years. The slope of the line gives a quick visual of the growth of real GDP over a period. Note the flatness of the line during the 1930s, as this corresponds with the low growth period during the Great Depression. The line turns sharply upward during the rapid growth of output during WW II. The 1950s and 1960s represented rather steady post-war growth until the oil shocks of the 1970s, when the real GDP stopped growing and actually fell. The next dramatic recession was during the Volker disinflation of 1981-2, (which we will return to later in the text) when, again, real GDP sharply fell. Over the second half of the 1980s and over the 1990s, with the exception of the short recession at the start of the 1990s, the US experienced relatively rapid growth. Just as we saw for the international comparisons, we hope that by the end of the text you will be able to explain what produced these differences in growth.

Figure 2.3:



Source: Survey of Current Business, Table 2A, "GDP and Other Major NIPA Series, 1929-2003, February 2004.

Real GDP Index

In order to make comparisons quickly across years, economists construct indexes. You have undoubtedly read about price indexes or output indexes. These indexes are series that show the change in a variable relative to some base year. They are constructed by taking the value of a variable, say the Real GDP in a given year, and computing the ratio of it to the Real GDP value in a base year. Normally, this ratio is multiplied by 100, so we can immediately see the percentage change in the variable over any given number of years.

Let's take the values for the Real GDP above, and construct an index with base year 2000.

Table 2.3: Real GDP and the Real GDP Index

Year	Real GDP	Real GDP Index (chained 2000 US $)
1960	2,501.8	25.5
1970	3,771.9	38.4
1980	5,161.7	52.6
1990	7,112.5	72.5
2000	9,817.0	100.0
2002	10,083.0	102.7

Source: Authors' Calculations from the *Economic Report of the President 2004*.

In the third column, we have the Real GDP Index; it is the ratio of the year's real GDP divided by the real GDP of 2000, multiplied by 100. So, for example, the index in 1960 is:

$$Real\ GDP\ Index_{1960} = (Real\ GDP_{1960})/(Real\ GDP_{2000}) = (2{,}501.8)/(9817) = 25.5$$

From this we can see that the Real GDP increased 74.5 percent over the 40 year period, an annual average increase of 1.86 percent. Indexes are very useful, and you should learn to use them easily. Also, you can see how the growth rates relate to the different periods of the Figure 3. Using the same procedure for the entire 40 year period, you can calculate the real Growth rates in the 1970s and the 1990s, and verify tshow that the growth rate in was nearly double in the 1990s.

Chain-Weighting and the Base Year

Accounting for price changes seems a simple idea, but, in practice, it is complicated. Note that in the Table above the values are in "Chained (2000) US Dollars." This is the

manner in which the National Income and Product Accounts presents real GDP data. Chain-weighting is an attempt to account for inherent biases in accounting for changes over time. In order to explain this, we need to understand the two basic ways of accounting for changes. In the one, known as the Paasche method, a current year values (prices for quantity indexes and quantities for price indexes) are used to weight base year and current year values So for the Paasche quantity index, the value of the current year quantities, valued at current year prices are compared with base year quantities, also valued at current year prices. The other method, known as the Laspeyres method, base-year values are held constant. In this method for the quantity index, the base year quantities are valued at base year prices as are the current year quantities.

A simple example will illustrate the difference between the two methods. We are computing real GDP indexes in order to tell the change in real GDP over time. Let's take an economy with just two goods, food and clothing. Let's assume that the table below shows the quantities and prices in two years.

Table 2.4: Two-Good Economy: Calculating the Paasche and Laspeyre's Quantity Indexes

	Year 1		Year 2	
	Prices	Quantities	Prices	Quantities
Food	1.0	10.0	.75	12.0
Clothing	2.0	6.0	2.0	6.0

Calculating with the Laspeyres method we get: [(1.0*12 + 2.0*6)/(1.0*10 + 2.0*6)] = 1.20.
Calculating the Paasche, we get: [(.75*12 + 2.0*6.0)/(.75*10.0+2.0*6.0)] = 1.03.

By how much did real output rise from year 1 to year 2? Like so many answers in economics, the answer is, "it depends." Here it depends on which method used to calculate the price change. Note that when we use the Laspeyres method, we underweight the amount of clothing in year 2. Food prices have decreased, and, not surprisingly, the amount of food purchased has risen. But, recall, in the Laspeyres method for computing the quantity index, we leave the base prices the same. Clearly, this leads to an upward bias. The index does not account for the substitution between or among goods, and it suffers from **substitution bias**. The Paasche index, too, has a bias, but it is in the other direction. The Paasche index has a systematic downward bias in calculating inflation.

Noting this, Irving Fisher constructed an index now, appropriately, known as the "Fisher Index" (also know as the "Ideal Index") that is the geometric average of both the Paasche and the Laspeyres indexes. For our example above the value for the ideal index would be:

$$Ideal\ Index = \sqrt{Paasche * Laspeyres} = \sqrt{(1.2)(1.03} = 1.11.6$$

Thus, we get a chain-weighted index of 111, showing that real GDP increased 11 percent. In order to created our chained series of real GDP index values, we would calculate the next years changes in the same manner. If for example we found a 8 percent increase we would have, using year 1 as the base year, a chain weighted index with base year 1 of 100, 111, 119.

Hedonic Pricing

Often the increase in benefit we receive from items over time changes faster than prices. When a good changes in form or quality, it is hard to gauge the price change; open

heart surgery might cost more than it did twenty years ago, but the operation today is almost incomparably better today than in the 1980s. These sorts of changes within goods or services needs to accounted for since we are interested in changes in economic well-being. We need to estimate the implicit value from the new features of the good. These valuations are made

Macroeconomic Origins

During the Great Depression, the Federal government became more involved in the economy and needed far better and more comprehensive economic data. It became obvious, too, that better data was needed to help businesses plan their strategies and for labor to negotiate their wages. The National Income and Product Accounts, as we now know them, were commissioned by The Department of Commerce. The Commerce Department asked Simon Kuznets of the National Bureau of Economic Research (NBER) to develop estimates of national income; Kuznets later won a Nobel Prize for for this work. The estimates were first presented in a report to the Senate in 1934, called *National Income, 1929–32*.[1]

With the needs of the United States during World War II, even more data was needed in order to facilitate wartime planning. Early in 1942, annual estimates of gross national product (GNP) were introduced to complement the estimates of national income. In addition, estimates were developed for how income was generated, received, and spent by the various sectors of the economy. The U.S. national income and product statistics were first presented as part of a complete and consistent accounting system in the July 1947 supplement to the SURVEY OF CURRENT BUSINESS.

Over the years, the figures have been updated and improved. In 991, the NIPA moved to report Gross Domestic Product figures rather than Gross National Product figures. This made the US figures easier to compare to international figures, which were almost exclusively given in GDP form. It also reflected the growing impact of foreign production in the US. In 1996, the NIPA accounts gave up estimating the changes in the real GDP with a simple Paasche index and moved to chaining together estimates using a Fisher index. In addition, Governmental expenditures for equipment and structures were (finally) recognized as fixed investment instead of simple expenditures. This made the important distinction between the Government's spending on goods and services, which we denote *G* in the text, and the Government's spending to keep account for public depreciation and changes in the public capital stock. In 1999 the figures underwent extensive revision, with features like business and government's expenditures on software being included in the category "equipment investment." In addition, banking services were reevaluated, as so many services are unpriced, and real personal expenditures were revised back to 1978 using the new geometric mean corrections for the Consumer Price Index.

[1]This brief history is drawn from "A Guide to the NIPA's"

using a technique called **Hedonic Pricing**. Hedonic price indexes are created by calculating the relative influence of a variety of characteristics of a good and then by controlling for

changes in each of the characteristics. Through this process products over time can meaningfully be compared even if the good is improving.

The classic example of such a good is computers. Categorized as simply a "computer," we could see that a luggable sort of portable computer in 1989 might cost about the same as a sleek, wildly powerful laptop in 2002. However, almost any meaningful measure would show that the 2002 machine is much cheaper. Over time, we must control for the change in computing power. In fact, the BEA estimates that over the past several years the quality adjusted prices of computers and peripherals have fallen by 24 percent.[7] Similar calculations have recently been undertaken for banking and insurance services. Incorporating these types of changes yield better estimates of how output is really changing over time.

Inflation

One of the most important estimates made is of the general inflation rate. The value of the inflation rate is used to compute productivity values, the poverty rate, government payments and thus projected and current budget deficits, just to name a few. Now, as we are well aware, the general increase in prices cannot be directly observed in the economy; it needs to be estimated since it is a composite of the prices in the economy. The inflation rate is the amount by which a weighted average of prices changes with respect to a base period. Estimation of the price indexes is done in a very similar manner as the quantity indexes we just examined. Just as in the quantity indexes, price indexes are produced using either the Paasche or the Laspeyres method. The two most frequently used measures of inflation

illustrate both of these: the implicit GDP deflator is a Paasche index, and the Consumer Price Index is a Laspeyres index.

Implicit GDP Price Deflator

In the simple Paasche method, we use the quantities from the current year and value these quantities at current and base year prices. Let's apply this Paasche method of calculating price changes to our tables of nominal and real GDP given in Tables 2.1 and 2.2. In the nominal GDP we have the product sum of current year quantities and current year prices, and with the real GDP we have current year quantities and base year prices. (adjusted by the chain-weighting) If we take their ratio, nominal GDP and real GDP, we have a Paasche-type measurement of how much prices have changed over the period. This ratio is called the **Implicit GDP Price Deflator**. Using the nominal and real values for 2002, we have:

$$\text{GDP Price Deflator}_{2002} = [(\text{Nominal GDP}_{2002})/(\text{Real GDP}_{2002})]*100 = (10{,}480.8)/(10{,}083.0)*100 = 103.98$$

From this index, we have a measure of inflation over the period 2000 to 2002: price increases were, on average 1.95 percent.[9]

In addition to calculating price changes and valuing real GDP, we can use the index to make comparisons of values across times for individual products. Throughout the book, we will be talking about "real wages." These are nominal wages deflated by the price index. Let's take an example, if someone made $30.00/hour in 2000 and was offered a ten percent raise in 2002, what would the change be in the wage's actual purchasing power, that is what is the change to the real wage? In order to figure this out we need to adjust the values for

any price changes. As shown above, the price deflator in 2002 is 103.9. This means that the value of $33 in 2000 dollars is $31.76, meaning a real wage increase of only 5.6 percent.[10]

Fast Facts

The **Implicit GDP Deflator** is the ratio of Nominal and Real GDP:

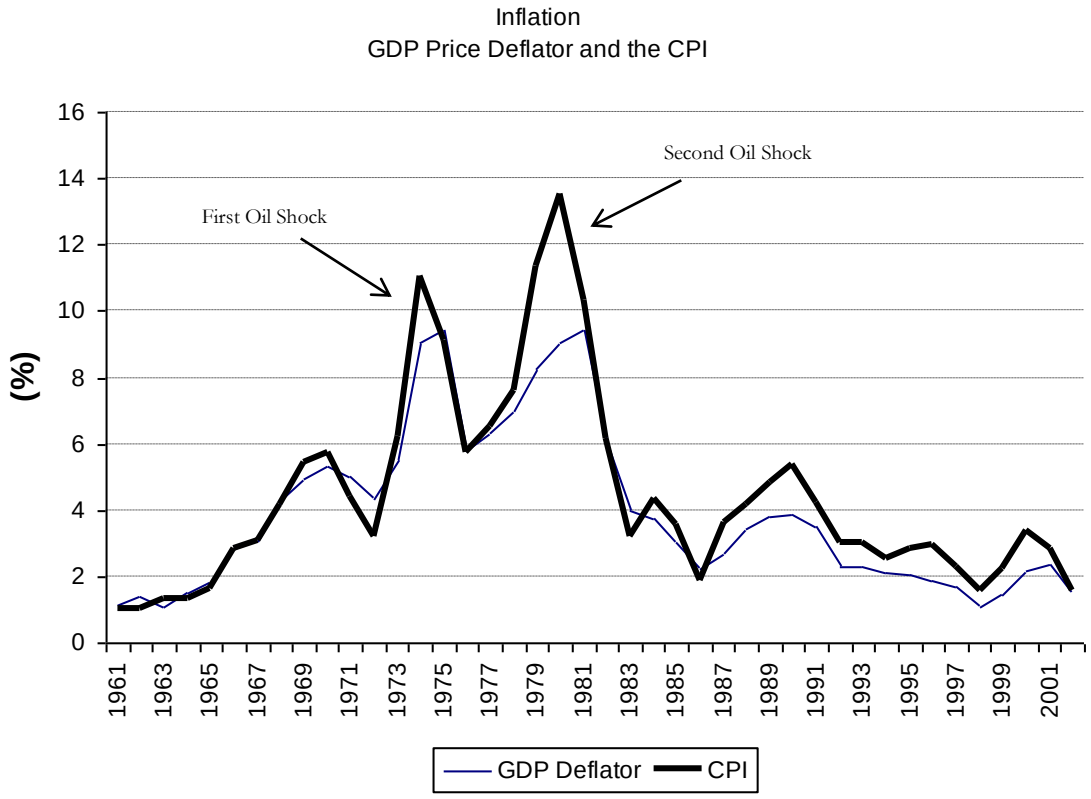
Implicit GDP Deflator = (Nominal GDP)/(Real GDP)

We can use the deflator to calculate price changes between years and to make comparisons between years.

The other measure of inflation is the Consumer Price Index. (CPI) Whereas the GDP price deflator looks at the whole economy, the CPI uses goods that typical households consume.[11] Calculating the CPI is a daunting process. In the United States, based on Consumer Expenditure Surveys, the Bureau of Labor Statistics (BLS) surveys over 70,000 goods and services at over 20,000 retail outlets in over 40 geographical areas. It is a Lespayres index that takes all the information gathered by the BLS and computes the change in the price of a set bundle of goods. The amount by which the value of the bundle changes over time is used as an estimate of the inflation rate.

Figure 2.4 below shows the CPI and the GDP price deflator for the period 1959-2002. Note that the two series move together, with the CPI generally being just a bit above the GDP price deflator. The similarity collapses in two periods, the early and late 1970s. These are the times of the two, large oil shocks that shook the US. They were times when imported oil prices rose 25 percent. Since the GDP price deflator does not include imported prices and the US had relatively large amounts of imported oil in the 1970s, it did not pick up this major change in oil prices. The CPI, however, did include the oil price changes as consumers experienced higher petroleum and heating oil prices.

Figure 2.4:



Bias in the CPI

We saw earlier that the Laspeyres index tends to provide an upwardly biased value. Since the CPI is directly used to compute so many values, perhaps its bias is affecting our estimates of those values. If the CPI were too high, then poverty rate estimates would also be too high, real GDP growth would be underestimated, as would real wage growth. To illustrate just how important this sort of bias can be, in 1996, a commission headed by Michael Boskin, estimated that the CPI was overstated by 1.1 percent; that is if inflation were estimated at 3.1 percent, its true figure would be around 2.0 percent. If this were indeed the case, the bias, alone, would account for about an accumulated $1 trillion in excess debt for the federal government in just twelve years! [12] The Boskin Committee showed that the

CPI has four major sources of bias: 1) Substitution Bias, 2) New Product Bias, 3) Quality Bias, and 4) Outlet Bias. Briefly, these biases are the product of attempting to keep the basket of goods remaining constant. As we saw earlier, the substitution bias occurs since the weights of the products remain fixed, goods whose prices are falling are underweighted and goods whose prices are rising are overweighted since the fixed bundle does not take into account consumers substituting expensive goods for cheaper goods. The new product and quality bias are the sources of the highest biases and stem from the product cylce and the difficulty in accounting for the improvement of goods. Finally, since consumers are continuously searching for lower prices, if the BLS is not using the stores from which consumers are actually buying their goods, the cost estimates might be too high.

Costs of Inflation

It is not obvious why people should care about prices changing. After all, if wages are rising with general prices, no *real* changes are taking place. Confusing changes in nominal values for changes in real values is known as **money illusion**. If people do not have money illusion, why should they care about inflation? Well, there might be several reasons. First, inflation, itself, might have several real effects. First, with unstable prices, firms have to change catalogues, price lists and renegotiate with customers and suppliers often. Changing prices have costs themselves. We call these types of costs **menu costs**. Secondly, if prices are changing rapidly transactions might cost more to undertake, as consumers make more trips to banks and search prices more often. These costs are often referred to as **shoe leather** costs.

The costs above are incurred whether all prices or only some prices are changing. When the general price level changes, not all goods' prices always change by the same amount. In fact, some prices are very sluggish to change. This means that products whose prices rapidly change with increase their relative value as the general price level increases. Economic agents will, of course, react to these relative price changes and reallocate resources toward the relatively more valued goods. However, this represents a misallocation of resources since the relative price change is spurious; it does not reflect any relative change in productivity. With higher rates of inflation, these spurious, relative price changes are larger and hence the misallocative effects are greater, too. Finally, in the US, inflation can have real tax effects by pushing people into higher tax brackets and by inflating capital gain values. [other countries?]

Unemployment

Over the past twenty years, most industrial nations have reduced their spending on social safety nets. Welfare payments, medical aid and unemployment compensation have become more difficult to qualify for, and so employment status has become even more important in order to maintain standards of living. In the macro-economy, one of the most important gauges of economic success is the percentage of unemployed potential works in the labor force. We know this rate as the **unemployment rate**. In order for us to be able to make sense of this measure, we must first define what we mean by the labor force and what we mean by "unemployed."

Measuring the status of workers in the labor market is the job of the Bureau of Labor Statistics. Each month, thousands of households are surveyed in order to determine working status. Those counted in the survey are over 16, non-institutionalized and not

retired. Of those satisfying these conditions, the labor force will comprise of those that are employed and unemployed. If a person worked in the last week for pay, even for one hour, he/she is considered employed. If a person is not working, though, it does not mean that he/she is unemployed. The BLS only counts those potential workers unemployed if:

1) a worker has received a job but is waiting to begin work,

2) a worker is temporarily laid off, and

3) has been looking for work but has been unable to find it. Thus the labor force is: for people greater than 16, non-institutionalized and non-retired:

Labor force = (Those working) +[(Those looking for work and unable to find it)+(Those temporarily laid off) + (Those hired but waiting to work)]

which is the same as,

Labor force = Employed + Unemployed.

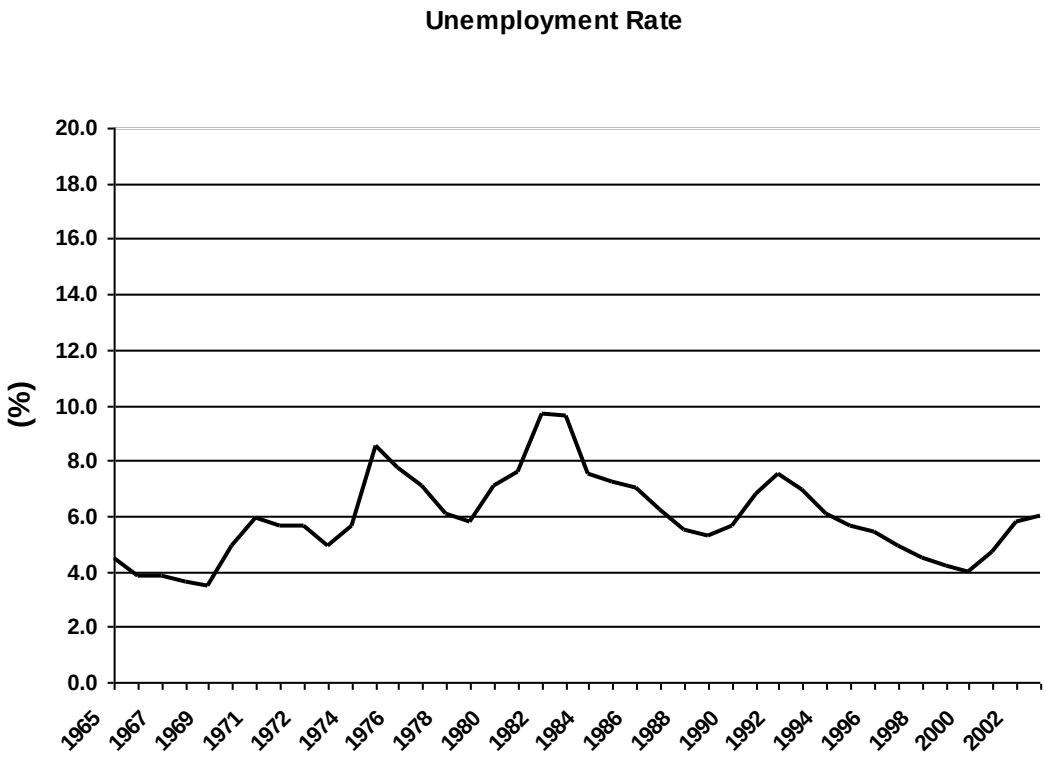
From this we see that the unemployment rate is simply the proportion of the labor force that is unemployed, or:

Unemployment Rate = (Unemployed)/(Labor Force)

Given the definition of the unemployment rate, we should not expect to see the rate at zero. Clearly, people need time to search for jobs, move between jobs, and wait for new work to begin. These sorts of unemployment spells are called **frictional unemployment**. Career Centers at universities are institutional attempts to reduce frictional unemployment. Note that reducing the friction might make unemployment lower, but it comes at a cost. [Typical Career Centers cost ($ /student) other measures]. Trying to push the unemployment rate down to zero would be very costly indeed.

Figure 2.5 shows the unemployment rate for the US since 1965. Notice that the rate is variable over time.

Figure 2.5:



Source: Table B-43, *Economic Report of the President 2004*.

Figure 2.6:

Source: Table B-43, *Economic Report of the President 2004*.

Figure 2.6 depicts unemployment rates for workers over 20 years old. The trends are those of the overall unemployment rate, but you can clearly see that "unemployment" affects groups very differently. In fact, over the period 1965-2003, black males over 20 years old had unemployment rates 2.2 times as high as white males. Throughout the book, we will not be paying much attention to the distribution of our aggregate variables since we will be focusing on aggregate values; however, we must remember that not everyone is affected the same by macroeconomic changes.

. As both Figures show, the unemployment rate varies rather significantly over time. One of the things we want to be able to do is try and understand these fluctuations and how they are related to the variation we saw in Gross Domestic Product. Earlier, we defined the natural level of output as the output level around which the economy fluctuates at any time. We noted that when output is at the natural level of output, inflation is neither rising nor falling. The same sort of concept can be applied to the unemployment rate: the unemployment rate for which inflation is neither rising nor falling (the unemployment rate generated at the natural output level) is called the **natural rate of unemployment**. When output is below the natural level of output, then unemployment exceeds the natural rate and we say that we have "**structural unemployment**."

Since output and unemployment are inversely related, can we establish a set relationship between them? The answer, it turns out, is yes. In the 1960s, Arthur Okun showed that for every 2% fall in unemployment, output would increase 1%. This relationship is known as **Okun's Law**. We will look at this relationship in greater detail in Chapter 9, but for now, we can see that output and unemployment are inversely related in this manner.

Why should we worry about the unemployment rate? Several reasons make high unemployment rates inadvisable. Of course, the central reason is that jobless, many people will have low standards of living which is counter to the main goal of macroeconomic policy: steady, stable increases in economic well being. Unemployment has been linked with higher incidences of crime and political instability. In addition, note that the unemployment rate does not include workers who have tried and tried to get work and have now given up. Since these workers, known as **discouraged workers**, are no longer looking for work, they are not included in the labor force. More than likely in periods of high unemployment, the number

of discouraged workers increases, exacerbating the problems mentioned above. These reasons alone make keeping the unemployment rate low and stable clearly an important goal. Another, more indirect, reason for low unemployment is that long periods of joblessness can lower worker productivity and thus make the probability of finding work even lower. As the role of technology increases in jobs, the costs of being away from work are probably increasing. This feedback is known as **hysterisis**. We will see that this issue is an important consideration when considering the speed at which an economy recovers from a recession. The United States has had relatively low levels of unemployment since 1950. The table below compares the US unemployment rate with several other countries.

Other Major Macroeconomic Variables

In addition to output and income measures, inflation and unemployment rates, several other values are important in macroeconomics. Among the many possibilities, we focus on interest rates, exchange rates and aggregate economic indicators.

Interest Rates

Interest rates are the prices paid by borrowers to lenders. The prices are calculated as percentages of the amount borrowed over a certain period of time, called the "**maturity**" of the loan. Many types of loans are made through a variety of forms; these forms are known as "**debt instruments**." Interest rates hold much information about the state of the supply and demand for loanable funds, expectations of future incomes and future inflation rates. Since these prices are paid over time, if the general price level changes over the time of the loan, then the real return of the loan will change. For example, suppose you lend someone $1000

with repayment to be made in one year at an interest rate of 10%. That would mean at the end of the year you would receive the $1000 dollars (the principle) and $100 in interest payments. But, the question that you are no doubt thinking about is, "what has happened to the purchasing power of $1000 over time?" If prices have increased, clearly the purchasing power of money has decreased. In fact, you can think of the return to holding money as the inverse of the interest rate. If the price level falls, the money you are now holding commands more goods, and if the price level increases then the opposite is true. Given this, we will make a distinction between the **nominal interest rate**, the actual percentage paid, and the **real interest rate**, the rate equal to approximately the nominal interest rate minus the inflation rate.[13] That is,

Real Interest Rate (r) = Nominal Interest Rate (i) – Inflation (π)

We will see that real interest rates determine the level of investment in the economy. Throughout the book, we will be talking about "the real interest rate," as if there were a single price of loanable funds. You know very well that there are hundreds of interest rates on various types of debt instruments and periods of maturity. The implicit interest rate on a bond, for example, is known as the yield to maturity and the yields vary over time. The manner in which they change over time is called the **term structure of interest rates**. As you can see already, we will see later that the term structure depends upon expectations of future inflation rates and states of the economy.

Exchange Rates

Countries, as you well know, have their own currencies. A US dollar anywhere within the US is simply a dollar. However, outside the US, a dollar must be converted or exchanged for the currency used there. Just as goods have prices, so do currencies *vis à vis* other currencies. In South Africa, they use a currency called the Rand; at the time of this writing, $1 US dollar is equal to 6.75 Rand. This is the nominal exchange rate of the US dollar and Rand. We will write the exchange rate as e, and place the foreign currency in terms of the domestic currency. So in the example of the Rand and dollar, we have:

nominal exchange rate = E = *(foreign price)/(US dollar) = 6.75*R/*1$*

As you can guess, just as for any good, the price of the dollar in terms of Rand is a function of the relative supply and demand for the currencies as well as the relative price levels of the two countries. If the price level is higher in one country than another, the exchange should reflect that. If the rate at which prices are rising, the inflation rate, rises in one country relative to another, the exchange rate should also reflect this. Why should this be so? Suppose that we take two bordering countries, Country A and Country B, with very few trade restrictions between them. Suppose that Country A's currency is Anklets and Country B's currency is bracelets. Currently 5 Anklets trade for 1 Bracelet. Let's suppose that winter wheat costs 40 Anklets/bushel in Country A. In Country B, wheat should cost around 8 Bracelets/bushel, otherwise arbitrage would exist in the wheat market. Now suppose the price level increases only in Country A, so that wheat now cost 48 Anklets in Country A. At the old exchange rate, there would be gains from buying wheat in B and selling it in A. What will happen? Well, pressure on the exchange rate from the arbitrage will

raise the exchange rate to 6 Anklets for 1 Bracelet. The relative increase in prices in Country A raised the exchange rate. We can generalize this with the definition of the real exchange rate as

*Real Exchange Rate = Nominal Exchange Rate (Foreign Price Level)/(Domestic Price Level) = e = E(P)/P**

And in rates of change,

$\%\Delta E = \%\Delta e + \pi^* - \pi$

Where the change in the nominal exchange rate accounts for all difference in the relative inflation rates, we say we have **purchasing power parity**. It is like the law of one price applying to exchange rates.

Aggregate Indicators

In addition to the basic measures, aggregate indexes are also calculated. Some of the most cited indexes are the Leading Index and the Consumer Confidence Index of the Conference Board The Conference Board, a economic think tank in New York City, calculates a "Consumer Confidence Index based on a representative sample of 5,000 U.S. households. With a base of 1985 =100, the index measures how positive consumers are about the economy. The other, the "Leading Index," is a more global index that is an aggregate of many indexes and measures. It includes factors such as an index of consumer expectations, stock prices, average weekly manufacturing hours, vendor performance and average weekly initial claims for unemployment insurance, building permits, interest rate spread , real money supply* and manufacturers' new orders for nondefense capital goods*. You can find these and other indicators at the following web sites:

http://www.conference-board.org/economics/

http://www.gpoaccess.gov/indicators/

Summary

The measures that we have discussed in this chapter will be used throughout this text and certainly in economic news reports that you read. As you begin to use these terms, remember how they are derived and exactly what they mean, and you will have a richer and clear understanding of the models that we develop and the news reports that you hear and read.

Key Points:

- The Gross Domestic Product (GDP) measures the value of the final goods and services produced in an economy.
- The National Income (NY) measures the value of the returns to all the factors producing the GDP. Even though, technically, NY and the GDP are different, throughout the text we will use the two interchangeably.
- Disposal Income (DY) is derived from NY and is the amount of income households have either to spend or save.
- Since both prices and quantities change over time, in order to understand how output is changing over time, we must account for price changes. We do this by computing the real GDP.
- In order to calculate changes over time quickly, economists construct indexes. The real GDP index measures how the real GDP has changed relative to the value in 2000.

- Accounting for prices is actually a complicated process. Instead of using a fixed, arbitrary base year, the National Income and Product Accounts use a method of chain weighting the changes and then links those changes to a base year in 2000.
- Inflation estimates are made using the implicit GDP price deflator and the Consumer Price Index. The GDP price deflator is the ratio of the nominal GDP to the real GDP and the Consumer Price Index (CPI) is the ratio of the value of a set, bundle of goods valued at base year prices to the value of the same bundle of goods valued at current year prices.
- The CPI has an inherent upward bias due to substitution bias, quality bias, new product bias and the outlet bias.
- The unemployment rate is not simply the percentage of people not working in the economy. Rather, it is the proportion of people within the labor force not working.
- Okun's Law relates changes in unemployment to changes in output. A historically stable value exists of double the change in unemployment inversely related to changes in output.
- The nominal interest minus the inflation rate approximates the real interest rate.
- The nominal exchange rate is simply the price of one currency in terms of another. The real exchange rate is the nominal exchange rate accounting for relative price differences in the two countries.

Endnotes

[1] Later, we will see that we can also take an "income approach" to total economic activity. In the income approach, the imputed rents are added to "Rental Income" in National Income.

[2] Nancy Folbre, "Valuing Parental Time: New Estimates of Expenditures on Children in the United States," Paper presented at the meetings of the 2002 Allied Social Science Association, Atlanta, GA.

[3] See Redefining Progress at http://www.redefiningprogress.org

[4] Until 1991, the NIPA reported the GNP figures. The GNP figures are larger than the GDP figures, reflecting the large foreign investments of US firms. Even though the series are different, the two are very similar. In fact the average difference between the two over the period 1929-2003 is only 0.6 percent.

[5] As Alan Auerbach and Kevin Hassert argue, the retained earnings should also influence stock holders, i.e. consumers, since they are owners of the company. They show that household spending is affected by large earnings as consumers rationally take the retained earnings into account in their own spending decisions. See Alan Auerbach and Kevin Hassett, "Corporate Savings and Shareholder Consumption," in B. Douglas Bernheim and John Shoven, eds. *National Saving and Economic Performance* Chicago, 1991.

[6] A geometric average is used because we are considering product sums, not simple sums. For more on the Fisher index, see

[7] J. Steven Landefeld and Bruce T. Grimm, "A Note on the Impact of Hedonics and Computers on Real GDP," *Survey of Current Business* December 2000, 18.
http://www.bea.gov/bea/articles/NATIONAL/NIPAREL/2000/1200hm.pdf

[8] The price deflators back from 1959-2002 are given in Table B-3 of the *Economic Report of the President 2004*.

[9] The NIPA also report a "Chain-Weighted GDP Deflator" but these rarely differ by much from the implicit deflator. As an example, in 2002, the implicit deflator was

[10] We calculate this by taking the ratio of the deflators and multiplying it by the dollar amount. Throughout the text, we will simply have the real wage w as the nominal wage W divided by the price index (which we will refer to as the "price level." We do this because we normalize the current year to the index being simply 1.

[11] The Bureau of Labor Statistics also calculates a Producers Price Index (PPI) for producer's goods and a Wholesale Price Index (WPI) of wholesale goods.

[12] Michael J. Boskin, Ellen R. Dulberger, Robert J. Gordon, Zvi Griliches, and Dale W. Jorgenson. "Consumer Prices, the Consumer Price Index, and the Cost of Living," *The Journal of Economic Perspectives*, 12(1), Winter 1998, 3.

[13] This is actually an approximation that we will employ throughout the book and holds when interest rates are not too high. To see this, suppose you wanted to calculate the real return over a year on an asset, say a loan X. At the end of the year, with no changes in the price level, the borrower would pay you, (1+i)X. But if the price level changes, then you must account for this change, as the example above suggests. Your real return would actually be:

$$X(1+r) = X(1+i)(P_t/P_{t+1})$$

Noting that we can write inflation, $\pi = (P_{t+1} - P_t)/P_t$,; we can rewrite the ratio of the prices as

$$1 + \pi = P_{t+1}/P_t$$

Giving us,

$$X(1+r) = X(1+i)(1+\pi) = r = i + r + i\pi.$$

When interest rates and inflation rates are low, the approximation $r = i + \pi$ works just fine. However, when rates are very high, as they have been in past years in Latin America, including the last term does make a difference. We will return to this later in the text.