

Lecture Notes: Chapter 2: Measuring the Macroeconomy

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The Importance of Data

Economics is a *social* science: it is about us, about what we do. Thus it shares with other social sciences one important source of information: introspection.

But economists are in a better position than most other social scientists as far as their sources of information are concerned. Everything that passes through the economy is priced and sold. Thus economists have quantitative data to work with: prices, quantities, and values.

The six key variables:

- Real GDP (Gross Domestic Product)
- The unemployment rate
- The inflation rate (that is, the proportional rate of change in the price level)
- The interest rate
- The level of the stock market
- The exchange rate.

Nominal Versus Real Exchange Rates

The nominal exchange rate is the relative price of two different kinds of money, as set in the *foreign exchange market*. Domestic exporters earn foreign currency when they export--sell goods to people abroad. Foreign producers earn domestic currency when they sell us imports--sell their goods to people here. Both then have a problem. Domestic exporters can't pay domestic workers with foreign currency. Foreign producers can't pay

foreign workers with domestic currency. Foreign producers need to trade the dollars they have earned for money that is useful to them. Domestic producers need to trade the foreign currency they have earned for dollars they can use.

How do foreign producers and domestic exporters solve this problem? They turn to the foreign exchange market, where those who have foreign currency but want dollars exchange it for dollars, and those who have dollars but want foreign currency exchange dollars for other currencies.

If the *nominal* exchange rate between the dollar (the currency of the United States) and the euro (the currency of the European Union) is $\$1.20 = \text{€}1.00$, then a single euro costs \$1.20 in U.S. currency. It takes less than one euro--0.83 euros and change--to buy a single dollar.

Economists, however, are more interested in the *real* exchange rate: the nominal rate adjusted for changes in the value of the currency.

Suppose a burst of inflation were to double the price level in the United States, so that everything that once cost \$1 in the U.S. now costs \$2, everything that used to cost \$2 now costs \$4, and so on. Suppose also that the nominal exchange rate were to change from $\$1.20 = \text{€}1.00$ to $\$2.40 = \text{€}1.00$. Before the burst of inflation you could sell goods in Europe for $\text{€}0.83$ (and change), turn the euros into \$1.00, and buy American goods. After the burst of inflation you could sell goods in Europe for $\text{€}0.83$ (and change), turn the euros into \$2.00, and buy... the exact same American goods as before. The change in the nominal exchange rate has offset the change in the U.S. price level. In this case the real exchange rate--the rate at which goods trade for goods—has not changed. The terms at which the goods of one country are traded for the goods of another are the same.

Now suppose that a burst of inflation were to double the price level in the United States, but that \$1.20 still exchanges for $\text{€}1.00$ on the foreign exchange market. Has the exchange rate changed? The nominal exchange rate has not changed: 0.83 (plus change) euros will still get you a paper dollar; \$1.20 will still get you a euro. However, that paper dollar will buy only as many goods in the United States as 50 cents would have bought before. The doubling of the U.S. price level, coupled with the unchanged nominal

exchange rate, means that the same quantity of U.S.-made goods will buy twice as many European-made goods. Thus the real exchange rate has halved.

To calculate the real exchange rate ε you need to know three pieces of information. First, you need to know the price level in the home country--call it P , for **P**rice. Second, you need to know the price level abroad-- call it by P^* . (It is conventional in macroeconomics to let *s stand for values abroad in foreign countries.) Third, you need to know the nominal exchange rate--call it e , for **e**xchange. You can then calculate the value of the real exchange rate by multiplying the nominal exchange rate by the ratio of the home price level to the foreign price level:

$$\varepsilon = e \times \frac{P}{P^*}$$

The Stock Market and Interest Rates

The Stock Market

We don't have to calculate the value of an index for the stock market because news agencies perform that task for the public already. The best--the most representative--index of the U.S. stock market is probably Standard and Poor's Composite Index, usually called the S&P 500. The index you will hear about most, however, is the Dow-Jones Industrial Average. But if the DJIA tells a different story from the S&P, ignore it: it is less representative of the market than the S&P.

Though we don't have to assemble and calculate a stock market index, we do have to divide the numbers reported in the news by some measure of the price level--usually either the *GDP deflator* or the *Consumer Price Index* [CPI].

The stock market is a sensitive indicator of the relative optimism or pessimism of investors, and therefore a good forecaster of future investment spending. The real value of the stock market sums up--in one number that is reported every day:

- The current level of earnings, or profits.

- Whether investors are optimistic (expecting long-run earnings to be above today's level) or pessimistic (expecting long-run earnings to be below today's level), and how optimistic or pessimistic they are.
- The current cost of capital--whether money is cheap and easy to borrow (in which case r is low) or expensive (in which case r is high).
- Attitudes toward risk: whether people are strongly averse to the risks involved in entrepreneurship (in which case σ^s is high) or willing to gamble on new industries and new businesses (in which case σ^s is low).

These are the factors that determine whether corporate managers' are willing to undertake investments to boost their companies' capital stocks. Thus the stock market summarizes all the information relevant to the economy-wide level of investment spending. It's usefulness as a summary of all the information relevant to determining investment spending is the reason it is one of the six key variables of macroeconomics.

Interest Rates

The interest rate is the price at which purchasing power can be shifted from the future into the present--borrowed today with a promise to pay it back with interest in the future. Interest is not a single lump sum, but an ongoing stream of payments made over time. Economists like to talk about "the" interest rate in the same way that they like to talk about "the" exchange rate. But just as there are a large number of different exchange rates, there are a large number of interest rates. Loans of higher risk carry higher interest rates: whoever you lent your money to might not pay it back--that is a risk you accepted when you lent in the first place. Loans of different duration carry different interest rates as well.

Moreover, the interest rates published in the newspaper are nominal rates: they tell how much money you earn in interest per year if you lend out a sum of dollars now and collect the principal at the loan's maturity. You will not be surprised to learn that economists are interested instead in the real interest rate: how much purchasing power over goods and services you get in the future in return for trading away your purchasing power over goods and services today.

When we calculate real exchange rates, or real stock values, or real GDP, we divide the nominal exchange rate or stock index value or nominal GDP level by the price level, but

that is not what we do to calculate real interest rates. Instead of dividing the nominal interest rate by the price level, we *subtract* the inflation rate--the percentage rate of change in the price level--from the nominal interest rate to get the real interest rate.

The Price Level and Inflation

The Consumer Price Index

The most frequently seen measure of the overall price level is the Consumer Price Index, or CPI. (Other measures of prices include, to name three, the Producer Price Index of prices paid not by consumers but by companies, the economy-wide GDP deflator, and the Domestic Purchases deflator.) The CPI is calculated and reported once a month by the Bureau of Labor Statistics. The CPI is an expenditure-weighted index, in which each good or service receives a weight equal to its share in total expenditure in the base year.

Using relative expenditure levels in a fixed base year as the weights in a price index produces a kind of index that economists call a Laspeyres index. The CPI is such a Laspeyres price index. Another type of index, a Paasche index, is in a sense the opposite of a Laspeyres index. A Laspeyres index of production or consumption counts up the current dollar value of what is produced or consumed, and divides by what the value of what is produced or consumed would have been if all commodities had sold for their prices in the base year. The expenditure weights in a Paasche index are variable: if expenditures on a particular good rise this year so it is a large part of the current dollar value, then that good's weight in the price index will rise too. The second most-often seen indicator of the price level, the GDP deflator, is a Paasche index.

In general, a Laspeyres index overstates price increases. In the real world, when some items become expensive consumers *substitute* and instead buy other items that remain cheap. But a Laspeyres index, because it is based on a fixed market basket of goods and services, does not take account of this substitution. Thus it suffers from what economists call *substitution bias*, and tends to overstate changes. A Paasche index, on the other hand, understates the increase in fruit prices. It calculates the difference between the price today

of the *fruit you bought* and their price back in the base year. The Paasche index takes account of substitution. But it doesn't take account of the fact that the substituted items are less valued than the items they replace. The Paasche index reports, in the example of Box 2.5, that the skyrocketing price of oranges has no effect on fruit prices: it makes no sense to say that a frost that makes oranges completely unaffordable has no effect on the price of fruit.

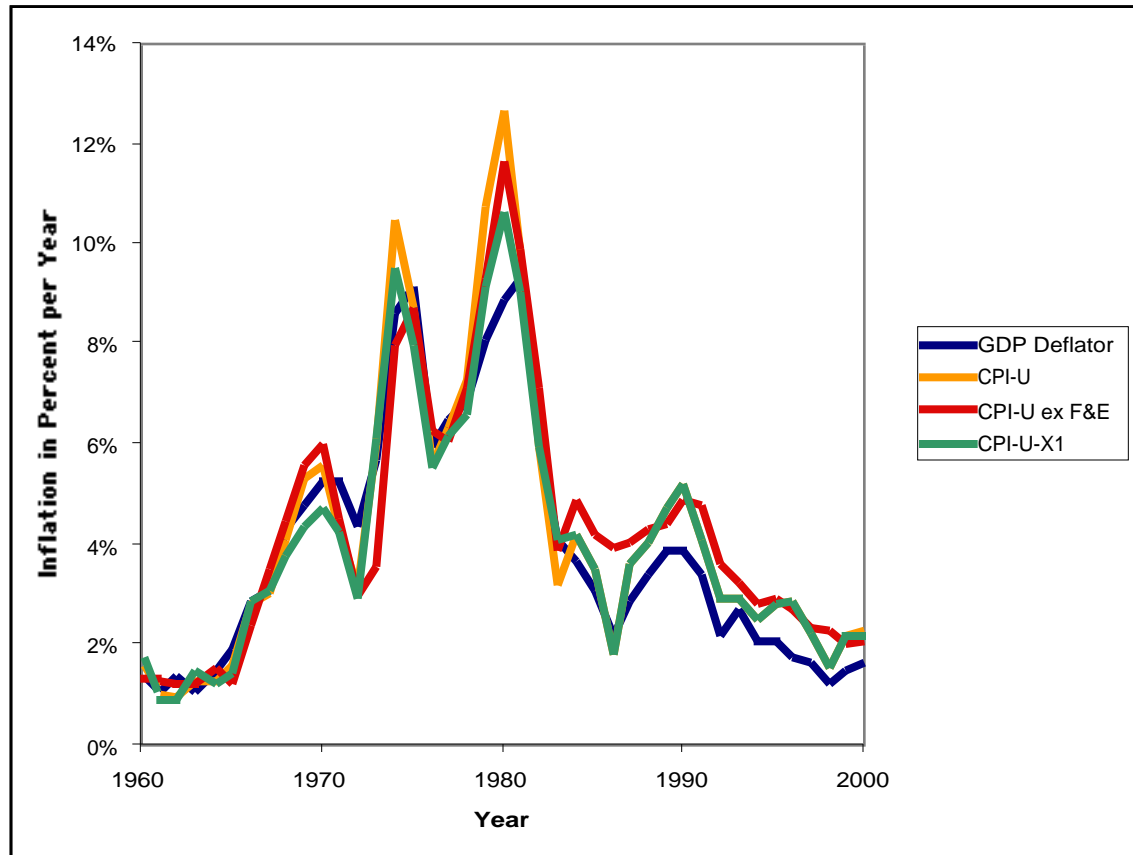
So which is the "correct" price index? The answer is that there is none. There is no final and definitive resolution to this "index number problem." All price indices are imperfect. All try to summarize in a single number what is inherently a multi-dimensional reality of many prices changing in different directions and different proportions.

To strike a balance between the two types of indexes and their two types of biases, the Commerce Department's Bureau of Economic Analysis and the Labor Department's Bureau of Labor Statistics have begun to move toward hybrid indices. To reduce substitution bias, the Bureau of Labor Statistics has begun using geometric averages--multiply two numbers together and take the square root--instead of arithmetic averages. And the Bureau of Economic Analysis has begun using a procedure called *chain weighting* to construct its indices.

The Inflation Rate

The CPI is reported once a month in the form of the percentage change in consumer prices over the preceding month. "Consumer prices in November rose 0.3% above their level in October," a newscaster will say. Eventually, twelve monthly changes in consumer prices over the course of the year are added up and become that year's inflation rate. "The consumer price inflation rate in 1999 was 2.7 percent," the newscaster will say.

Different Measurements of Inflation in the U.S., 1960-2000



Unemployment

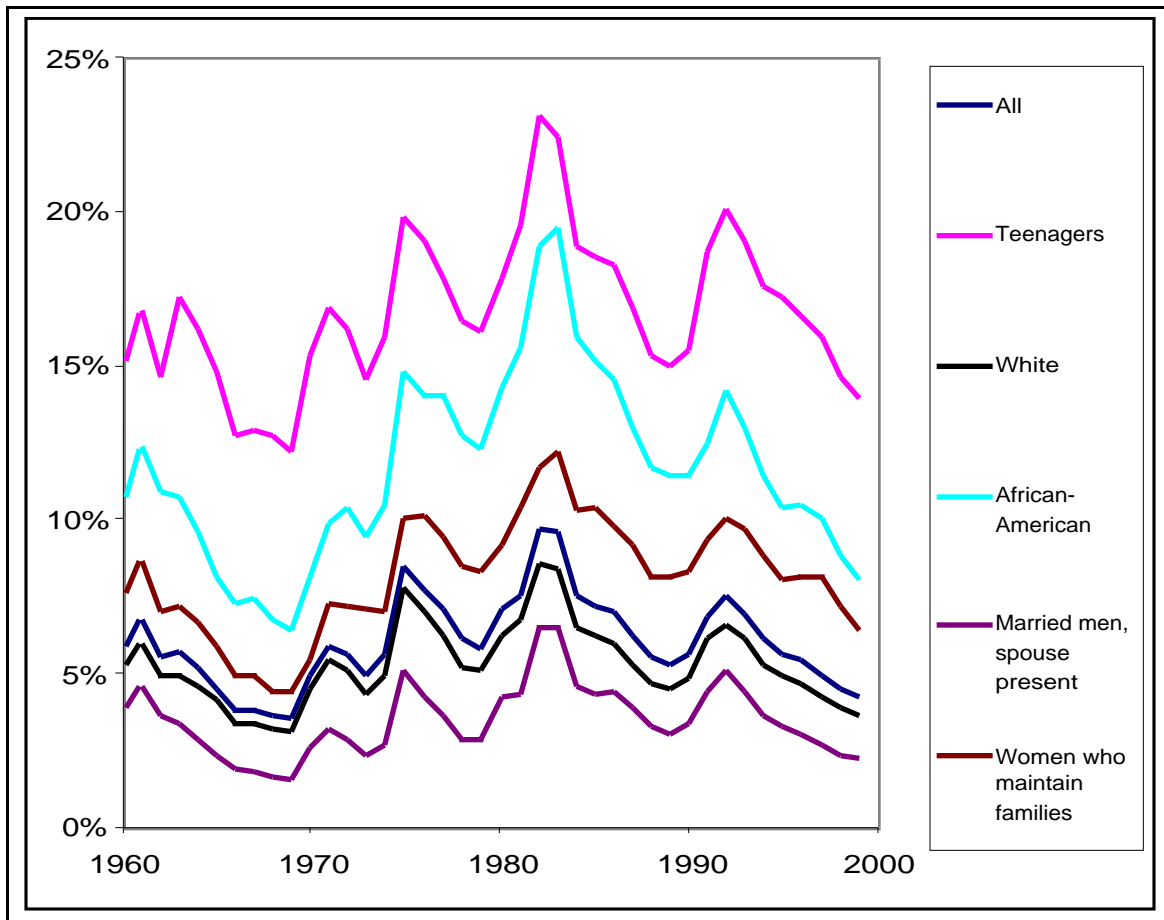
The unemployment rate is a key indicator of economic performance. An economy with persistent high unemployment is wasting its productive resources: its level of output is below its productive potential. Such an economy surely has a lower level of social welfare than might easily be attained. Being unemployed is not pleasant, not is fearing unemployment for no other reason than the turning of the wheel of the business cycle.

Keeping unemployment low is one of the chief goals of macroeconomic policy.

The official unemployment rate may well underestimate the real experience of unemployment. Someone in group (3), who wants a job but has given up looking, certainly feels unemployed, and may well feel as unemployed as someone in group (4). Perhaps these *discouraged workers* should be included in the unemployment rate. Furthermore, some people in group (1) have part-time jobs but want full-time jobs. Perhaps these *part-time for economic reasons* should be counted as unemployed, or as half-unemployed.

Economists have noted striking and persistent variations in unemployment by demographic group and class. Teenagers age 16 to 19 have higher unemployment rates than adults, African-Americans have higher unemployment rates than whites, and high-school dropouts have higher unemployment rates than those who have post-graduate degrees. For most of the post-WWII period (but not recently) women have had higher unemployment rates than men. Significantly, recessions don't just raise the unemployment rate: they disproportionately raise the unemployment rate among these high-unemployment groups. Figure 2.7 contrasts the unemployment rates of various groups of workers.

U.S. Unemployment Rate by Demographic Group, 1960-2000



Okun's Law

In the United States since World War II, the unemployment rate has been tightly coupled with the rate of growth of real GDP in a relationship called Okun's Law (see Figure 2.8).

$$(\text{Percentage Change in Real GDP}) = (\text{Percentage Growth in Potential Output}) - 2.5 \times (\text{Percentage-Point Change in Unemployment Rate})$$

Because of Okun's Law, if you know what is happening to real GDP relative to potential output, you have a good idea of what is happening to the unemployment rate--and vice versa. Box 2.6 explains the details of Okun's Law at greater length.

Why the Okun's Law Coefficient Is so Large?

Okun's Law posits not a 1-to-1 relation but a 2.5-to-1 relationship between real GDP growth and the unemployment rate. That is, a one percentage-point fall in the unemployment rate is associated not with a 1 but a 2.5 percent boost in the level of production.

Why is this Okun's Law coefficient so large? Why isn't it the case that a one percentage point fall in unemployment produces a one percent rise in output, or even less? One answer is that the unemployment rate, as officially measured, does not count discouraged workers. In a recession, the number of people at work falls, the number of people looking for work rises, and the number of people who are not looking for work because they doubt they could find jobs--but would be working if business conditions were better--rises. Because the conventionally-measured unemployment rate does not include these discouraged workers, more than a 1 percent rise in real GDP is needed to reduce the unemployment rate by 1 percentage point.

Moreover, when business returns to normal, firms' initial response is not to hire more employees, but to ask existing employees to work longer hours. So average hours of work per week go up, and the unemployment rate falls by less than one would otherwise expect.

Finally, in some industries employing more workers increases production by more than a proportional amount: product design and set-up need to be done only once, no matter how much is produced. Thus businesses which have *economies of scale* do not need twice as many workers to produce twice as much output.

Real GDP

Sixth and last of the key economic variables is real GDP. Other measures are close cousins of real GDP: GNP (Gross National Product), NNP (Net National Product), NDP (Net Domestic Product), and NI (National Income). And you will hear commentators refer to "total output," "total production," "national product," "total income," and

"national income." Except when you are focusing explicitly on the details of the National Income and Product Accounts [NIPA], treat all these terms as synonyms for real GDP.

Calculating Real GDP

Real GDP is calculated by adding up the value of all final goods and services produced in the economy. Because it measures the rate at which goods and services are produced, real GDP is a flow variable; it is usually expressed as an annual amount. Often, however, you will not hear the phrase "per year." But when you hear that real GDP in the fourth quarter of 2002 was such-and-such, remember such a statement means that the flow of production in the fourth quarter was such-and-such *per year*. And when you hear that real GDP in the fourth quarter of 2002 grew at so-and-so a percent, remember that such a statement means that real GDP in the fourth quarter grew at so-and-so a percent *per year*—the difference between real GDP in the third quarter and real GDP in the fourth quarter is only one-quarter of the reported annual growth rate.

What are the final goods and services that make up GDP? A final good or service is something that is not used further in production during the course of that year. Thus final goods and services include:

- Everything bought by consumers
- Everything bought by businesses not as an input for further production, but as an investment to increase the business's capital stock and expand its future production capacity
- Everything bought by the government.

Because GDP measures *product* and not *spending*, it includes a balancing item, exports minus imports. Because imported goods bought by consumers, installed as pieces of investment, or bought by the government were not made in the United States, they are not part of Gross Domestic *Product*, so imports need to be subtracted from GDP. Because exported goods bought by foreigners *were* made in the United States, they *are* part of GDP, and need to be added to the total.

Intermediate Goods

GDP is defined as the market value of *final goods and services* produced. Thus so-called "intermediate goods"--goods sold to another business for use in further production--are excluded from GDP. A product made by one business and sold to another will eventually show up in the National Income and Product Accounts [NIPA] and be counted as part of GDP. It will show up when the second business sells its product (which will by then embody the value added by the first producer) to a consumer, an investor, a foreign purchaser, or the government. Meanwhile, because the value of an intermediate good is included in the price of the final good that the intermediate good is used to make, its value must be excluded from GDP.

For example, if a builder buys wood from a lumber mill to build a house, the value of the wood becomes part of the value of the house. To count the value of the wood again--to include the sale of the wood to the home builder as well as the sale of the newly-built house to its purchaser--would be to count the wood twice. And what would happen if the builder bought the lumber mill, so that he or she no longer had to buy finished wood? GDP should not go down just because two businesses have merged.

Inventories

What happens if the production process is not finished when the end of the year rolls around, and the Commerce Department's Bureau of Economic Analysis closes the books on that year's GDP calculation? Some intermediate goods will not have been used to produce goods for final sale. The value has already been added in making the intermediate good, but no final good that embodies that value has yet been sold. The NIPA finesses this problem by treating inventories at the end of a period as a special kind of final good, a form of investment. A business that produces intermediate goods or final goods and doesn't sell them by the end of the year is treated as having "purchased" those goods for itself as part of its capital stock. The general rule is that whenever a business increases its end-of-period inventory, that increase is counted as a component of investment, and of final demand.

Imputations

What about goods and services that are produced and consumed but not sold in the marketplace? Such goods and services lack prices and market values; how are they counted in GDP? In some cases national income accounts estimate--they guess, really--what goods or services would have sold for on the market if there had been a market.

The largest such "imputation" in the NIPA is found in housing. When somebody rents an apartment or a house, the rent they pay to the landlord becomes part of GDP as the purchase of "housing services" by the renter. When a landlord rents a house to a tenant, he or she is selling a service--the usefulness of having their roof over the renter's head--just as much as a barber is selling a service when a customer gets a haircut. Thus rent is one item in consumer spending on services. Accountants enter it as a component of expenditure in the FIRE (finance, insurance, and real estate) sector, a large component of consumer demand.

However, a little more than half of Americans own their own houses and are their own landlords.

Components of Real GDP

How does the Commerce Department's Bureau of Economic Analysis [BEA] construct its measure of real GDP? The Bureau includes in its measure of real GDP, which we will always denote by a Y in equations and diagrams, the values of:

- Goods and services that are ultimately bought and used by households (except for newly constructed buildings); these goods and services are termed consumption spending (denoted C).
- Goods and services (including newly constructed buildings) that become part of society's business or residential capital stock; these goods and services are termed investment spending (denoted I). Gross investment spending is divided into two parts: the capital consumption allowance, or the depreciation of worn-out or obsolete capital; and net investment which increases the total capital stock. Investment can also be divided into four components: houses and apartments (residential structures), other buildings and infrastructure (non-residential structures), machines (producers' durable equipment), and as we noted above the change in business inventories.
- Government purchases (denoted by G); note that government purchases do not include any payments the government makes that are not payment for a good or service provided to the government.
- Finally, net exports (denoted NX) are a balancing item included in GDP; the GDP total needs to be adjusted for the difference between exports and imports to make the National Income and Product Accounts consistent.

Accountants add up all of these components to arrive at GDP (see Table 2.8). This definition of GDP, the national income identity, is one of the most fundamental bases of macroeconomics:

$$Y = C + I + G + NX$$

This is the equation that you will write down more than any other during any macroeconomics course.

What Is and Is Not in GDP

Depreciation and Net Output.

GDP counts *all* investment--including replacement investment--in its measure of total economic activity, for the measure of investment included in real GDP is gross investment.

Why is replacement investment included in real GDP? Why is it seen not as a cost of doing business but instead as the near-equivalent of building a new factory to expand the business's productive capacity? Depreciation expenditures are counted in real GDP because the statisticians who compile the NIPA have no confidence in their estimates of economy-wide depreciation. A better measure of economic activity is NDP, net domestic product, which includes only net investment and excludes depreciation. However, the national income accountants prefer to focus attention on measures that they think are reasonably accurate, and so downplay the (poorly measured) NDP and play up the GDP estimate.

Government Purchases

Government purchases of goods and services are also counted in GDP. The government uses the goods and services it purchases: it builds roads, provides police protection and courts, runs schools, issues weather reports, maintains the national parks, during the Cold War it maintained armies in West Germany to deter a Russian attack on Europe, and so on.

Many of these services, if they were provided by private businesses, would be counted as intermediate goods--things that are not of final value themselves but instead are aids to private-sector production. As such, they would be excluded from the GDP.

Think about it. Suppose two companies made a contract that a certain arbitrator would be the judge of any disputes that arose between them, and suppose they paid the arbitrator a retainer. The services of the private judge that they hired would be classified the NIPA as an *intermediate good*, and not included in the final goods and services added up to calculate GDP.

Nevertheless, *all* government purchases of goods and services are counted as part of GDP, including the money the government collects in taxes and then pays to its own judges, bailiffs, and clerks many of whom decide business-to-business disputes. A large chunk of government purchases fall into this category. They are counted as part of GDP, but would not be counted had they been made for analogous substantive purposes by private businesses.

What Isn't in GDP But Should Be

Moreover, many expenditures excluded from the NIPA, and thus from GDP, probably should not be. Production that takes place within the household is excluded from GDP. That is, the work family members do to keep their own households going, for which they are not paid, is excluded from GDP.

This exclusion warps our picture of the U.S. economy. In 2000 some 129 million Americans, male and female, worked a total of about 206 billion paid hours (and some 7 million Americans spent a total of 5 billion hours looking for jobs). But many Americans--most of them adult women--will also spend at least 100 billion hours performing services--such as cooking, cleaning, shopping, and chauffeuring--that would count as employment and would count in GDP if they were receiving pay for them rather than doing them for their own families. As Figure 2.9 shows, only a little more than 30 percent of American women were counted in the labor force in 1948, even though most of them would have said that they worked a full day. Within-the-household production has never been counted as part of GDP. Back when the NIPA system was set up, economists believed that it would be difficult or impossible to obtain reasonable, credible, and defensible estimates of the economic value of within-the-household production.

Depletion, Pollution, and "Bads"

Finally, the NIPA system makes no allowance for the depletion of scarce natural resources. To the extent that an economy produces a high income in the act of using up valuable natural resources, that income is not true GDP at all but the depletion of natural resources. Kuwait, Qatar, and Saudi Arabia have high levels of measured real GDP per worker, but much of their income arises not out of sustainable production but out of the sale of limited and depletable natural resources. A better system would have a category for the depletion of natural resources.

Moreover, the NIPA contain no category for the production of "bads"--things that you would rather *not* have. Producing more smog does not diminish GDP. The extra cases of lung cancer produced by cigarette smoking do not diminish GDP (indeed, they raise the medical care sector's contribution to GDP). If the demand for locks and alarm systems rises because crime increases, GDP increases. As noted before, GDP is a measure of the economy's level of productive effort only, not of well-being.