GLOBAL EDITION

# Principles of Macroeconomics

THIRTEENTH EDITION

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## ECONOMICS IN PRACTICE

### GDP: One of the Great Inventions of the 20th Century

As the 20th century drew to a close, the U.S. Department of Commerce embarked on a review of its achievements. At the conclusion of this review, the Department named the development of the national income and product accounts as "its achievement of the century."

J. Steven Landefeld *Director, Bureau of Economic Analysis*

While the GDP and the rest of the national income accounts may seem to be arcane concepts, they are truly among the great inventions of the twentieth century.

Paul A. Samuelson and William D. Nordhaus

GDP! The right concept of economy-wide output, accurately measured. The U.S. and the world rely on it to tell where we are in the business cycle and to estimate long-run growth. It is the centerpiece of an elaborate and indispensable system of social accounting, the national income and product accounts. This is surely the single most innovative achievement of the Commerce Department in the 20th century. I was fortunate to become an economist in the 1930s when Kuznets, Nathan, Gilbert, and Jaszi were creating this most important set of economic time series. In economic theory, macroeconomics was just beginning at the same time. Complementary, these two innovations deserve much credit for the improved performance of the economy in the second half of the century.

James Tobin


### From The *Survey of Current Business*

Prior to the development of the NIPAs [national income and product accounts], policy makers had to guide the economy using limited and fragmentary information about the state of the economy. The Great Depression underlined the problems of incomplete data and led to the development of the national accounts:

One reads with dismay of Presidents Hoover and then Roosevelt designing policies to combat the Great Depression of the 1930s on the basis of such sketchy data as stock price indices, freight car loadings, and incomplete indices of industrial production. The fact was that comprehensive measures of national income and output did not exist at the time. The Depression, and with it the growing role of government in the economy, emphasized the need for such measures and led to the development of a comprehensive set of national income accounts.

Richard T. Froyen

In response to this need in the 1930s, the Department of Commerce commissioned Nobel laureate Simon Kuznets of the National Bureau of Economic Research to develop a set of national economic accounts.… Professor Kuznets coordinated the work of researchers at the National Bureau of Economic Research in New York and his staff at Commerce. The original set of accounts was presented in a report to Congress in 1937 and in a research report, *National Income, 1929–35*.

The national accounts have become the mainstay of modern macroeconomic analysis, allowing policy makers, economists, and the business community to analyze the impact of different tax and spending plans, the impact of oil and other price shocks, and the impact of monetary policy on the economy as a whole and on specific components of final demand, incomes, industries, and regions.

#### CRITICAL THINKING

1. The articles emphasize the importance of being able to measure an economy's output to improve government policy. Looking at recent news, can you identify one economic policy debate or action that referenced GDP?

*Source:* U.S. Department of Commerce, Bureau of Economic Analysis, Washington, DC." *Survey of Current Business*, January 2000, pp. 6–9.

## Calculating Real GDP MyLab Economics Concept Check

Nominal GDP adjusted for price changes is called *real GDP*. All the main issues involved in computing real GDP can be discussed using a simple three-good economy and 2 years. Table 6.6 presents all the data that we will need. The table presents price and quantity data for 2 years and three goods. The goods are labeled *A*, *B*, and *C*, and the years are labeled 1 and 2. *P* denotes price, and *Q* denotes quantity. Keep in mind that everything in the following discussion, including the discussion of the GDP deflation, is based on the numbers in Table 6.6. Nothing has been brought in from the outside. The table is the entire economy.

The first thing to note from Table 6.6 is that *nominal output*—in current dollars—in year 1 for good *A* is the number of units of good *A* produced in year 1 (6) times the price of good *A* in year 1 ($0.50), which is $3.00. Similarly, nominal output in year 1 is $7 \times \$0.30 = \$2.10$ for good *B* and $10 \times \$0.70 = \$7.00$ for good *C*. The sum of these three amounts, $12.10 in column 5, is nominal GDP in year 1 in this simple economy. Nominal GDP in year 2—calculated by using the year 2 quantities and the year 2 prices—is $19.20 (column 8). Nominal GDP has risen from $12.10 in year 1 to $19.20 in year 2, an increase of 58.7 percent.[3]

You can see that the price of each good changed between year 1 and year 2—the price of good *A* fell (from $0.50 to $0.40) and the prices of goods *B* and *C* rose (*B* from $0.30 to $1.00; *C* from $0.70 to $0.90). Some of the change in nominal GDP between years 1 and 2 is as a result of price changes and not production changes. How much can we attribute to price changes and how much to production changes? Here things get tricky. The procedure that the BEA used before 1996 was to pick a **base year** and to use the prices in that base year as weights to calculate real GDP. This is a **fixed-weight procedure** because the weights used, which are the prices, are the same for all years—namely, the prices that prevailed in the base year.

**base year** The year chosen for the weights in a fixed-weight procedure.

**fixed-weight procedure** A procedure that uses weights from a given base year.

Let us use the fixed-weight procedure and year 1 as the base year, which means using year 1 prices as the weights. Then in Table 6.6, real GDP in year 1 is $12.10 (column 5) and real GDP in year 2 is $15.10 (column 6). Note that both columns use year 1 prices and that nominal and real GDP are the same in year 1 because year 1 is the base year. Real GDP has increased from $12.10 to $15.10, an increase of 24.8 percent.

Let us now use the fixed-weight procedure and year 2 as the base year, which means using year 2 prices as the weights. In Table 6.6, real GDP in year 1 is $18.40 (column 7) and real GDP in year 2 is $19.20 (column 8). Note that both columns use year 2 prices and that nominal and real GDP are the same in year 2, because year 2 is the base year. Real GDP has increased from $18.40 to $19.20, an increase of 4.3 percent.

This example shows that growth rates can be sensitive to the choice of the base year—24.8 percent using year 1 prices as weights and 4.3 percent using year 2 prices as weights. For many policy decisions, the growth rates of the economy play an important role so that large differences coming from a seemingly arbitrary choice of base year is troubling. The old BEA procedure

**TABLE 6.6 A Three-Good Economy**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Production | | Price per Unit | | | | | |
| | Year 1 $Q_1$ | Year 2 $Q_2$ | Year 1 $P_1$ | Year 2 $P_2$ | GDP in Year 1 in Year 1 Prices $P_1 \times Q_1$ | GDP in Year 2 in Year 1 Prices $P_1 \times Q_2$ | GDP in Year 1 in Year 2 Prices $P_2 \times Q_1$ | GDP in Year 2 in Year 2 Prices $P_2 \times Q_2$ |
| Good *A* | 6 | 11 | $0.50 | $0.40 | $ 3.00 | $ 5.50 | $ 2.40 | $ 4.40 |
| Good *B* | 7 | 4 | 0.30 | 1.00 | 2.10 | 1.20 | 7.00 | 4.00 |
| Good *C* | 10 | 12 | 0.70 | 0.90 | 7.00 | 8.40 | 9.00 | 10.80 |
| Total | | | | | $12.10 Nominal GDP in Year 1 | $15.10 | $18.40 | $19.20 Nominal GDP in Year 2 |

[3]The percentage change is calculated as $[(19.20 - 12.10)/12.10] \times 100 = .587 \times 100 = 58.7$ percent.

simply picked one year as the base year and did all the calculations using the prices in that year as weights. The new BEA procedure makes two important changes. The first (using the current example) is to take the average of the two years' price changes, in other words, to "split the difference" between 24.8 percent and 4.3 percent. What does "splitting the difference" mean? One way is to take the average of the two numbers, which is 14.55 percent. What the BEA does is to take the *geometric* average, which for the current example is 14.09 percent.[4] These two averages (14.55 percent and 14.09 percent) are quite close, and the use of either would give similar results. The point here is not that the geometric average is used, but that the first change is to split the difference using some average. When prices are going up, this procedure will lower the estimates of real growth rates relative to the use of year 1 as a base year, and conversely when prices are falling. Note that this new procedure requires two "base" years because 24.8 percent was computed using year 1 prices as weights and 4.3 percent was computed using year 2 prices as weights.

The second BEA change is to use years 1 and 2 as the base years when computing the percentage change between years 1 and 2, then use years 2 and 3 as the base years when computing the percentage change between years 2 and 3, and so on. The two base years change as the calculations move through time. The series of percentage changes computed this way is taken to be the series of growth rates of real GDP. So in this way, nominal GDP is adjusted for price changes. To make sure you understand this, review the calculations in Table 6.6, which provides all the data you need to see what is going on.

## Calculating the GDP Deflator MyLab Economics Concept Check

We now switch gears from real GDP, a quantity measure, to the GDP deflator, a price measure. One of economic policy makers' goals is to keep changes in the overall price level small. For this reason, policy makers not only need good measures of how real output is changing but also good measures of how the overall price level is changing. The GDP deflator is one measure of the overall price level. We can use the data in Table 6.6 to show how the BEA computes the GDP deflator.

In Table 6.6, the price of good *A* fell from \$0.50 in year 1 to \$0.40 in year 2, the price of good *B* rose from \$0.30 to \$1.00, and the price of good *C* rose from \$0.70 to \$0.90. If we are interested only in how individual prices change, this is all the information we need. However, if we are interested in how the overall price *level* changes, we need to weight the individual prices in some way. Is it getting more expensive to live in this economy or less expensive? In this example that clearly depends on how people spend their incomes. So, the obvious weights to use are the quantities produced, but which quantities—those of year 1 or year 2? The same issues arise here for the quantity weights as for the price weights in computing real GDP.

Let us first use the fixed-weight procedure and year 1 as the base year, which means using year 1 quantities as the weights. Then in Table 6.6, the "bundle" price in year 1 is \$12.10 (column 5) and the bundle price in year 2 is \$18.40 (column 7). Both columns use year 1 quantities. The bundle price has increased from \$12.10 to \$18.40, an increase of 52.1 percent.

Next, use the fixed-weight procedure and year 2 as the base year, which means using year 2 quantities as the weights. Then the bundle price in year 1 is \$15.10 (column 6), and the bundle price in year 2 is \$19.20 (column 8). Both columns use year 2 quantities. The bundle price has increased from \$15.10 to \$19.20, an increase of 27.2 percent.

This example shows that overall price increases can be sensitive to the choice of the base year: 52.1 percent using year 1 quantities as weights and 27.2 percent using year 2 quantities as weights. Again, the old BEA procedure simply picked one year as the base year and did all the calculations using the quantities in the base year as weights. First, the new procedure splits the difference between 52.1 percent and 27.2 percent by taking the geometric average, which is 39.1 percent. Second, it uses years 1 and 2 as the base years when computing the percentage change between years 1 and 2, years 2 and 3 as the base years when computing the percentage change between years 2 and 3, and so on. The series of percentage changes computed this way is taken to be the series of percentage changes in the GDP deflator, that is, a series of inflation rates.

[4]The geometric average is computed as the square root of $124.8 \times 104.3$, which is 114.09.

## The Problems of Fixed Weights MyLab Economics Concept Check

To see why the BEA switched to the new procedure, let us consider a number of problems using fixed-price weights to compute real GDP. First, 1987 price weights, the last price weights the BEA used before it changed procedures, are not likely to be accurate for, say, 2014. Many structural changes took place in the U.S. economy between 1987 and 2014, and it seems unlikely that 1987 prices are good weights to use for this much later period.

Another problem is that the use of fixed-price weights does not account for the responses in the economy to supply shifts. Perhaps bad weather leads to a lower production of oranges in year 2. In a simple supply-and-demand diagram for oranges, this corresponds to a shift of the supply curve to the left, which leads to an increase in the price of oranges and a decrease in the quantity demanded. As consumers move up the demand curve, they are substituting away from oranges. If technical advances in year 2 result in cheaper ways of producing computers, the result is a shift of the computer supply curve to the right, which leads to a decrease in the price of computers and an increase in the quantity demanded. Consumers are substituting toward computers. (You should be able to draw supply-and-demand diagrams for both cases.) Table 6.6 shows this tendency. The quantity of good *A* rose between years 1 and 2 and the price decreased (the computer case), whereas the quantity of good *B* fell and the price increased (the orange case). The computer supply curve has been shifting to the right over time, primarily because of technical advances. The result has been large decreases in the price of computers and large increases in the quantity demanded.

To see why these responses pose a problem for the use of fixed-price weights, consider the data in Table 6.6. Because the price of good *A* was higher in year 1, the increase in production of good *A* is weighted more if we use year 1 as the base year than if we used year 2 as the base year. Also, because the price of good *B* was lower in year 1, the decrease in production of good *B* is weighted less if we use year 1 as the base year. These effects make the overall change in real GDP larger if we use year 1 price weights than if we use year 2 price weights. Using year 1 price weights ignores the kinds of substitution responses discussed in the previous paragraph and leads to what many believe are too-large estimates of real GDP changes. In the past, the BEA tended to move the base year forward about every 5 years, resulting in the past estimates of real GDP growth being revised downward. It is undesirable to have past growth estimates change simply because of the change to a new base year. The new BEA procedure avoids many of these fixed-weight problems.

Similar problems arise when using fixed-quantity weights to compute price indexes. For example, the fixed-weight procedure ignores the substitution away from goods whose prices are increasing and toward goods whose prices are decreasing or increasing less rapidly. The procedure tends to overestimate the increase in the overall price level. As discussed in the next chapter, there are still a number of price indexes that are computed using fixed weights. The GDP deflator differs because it does not use fixed weights. It is also a price index for all the goods and services produced in the economy. Other price indexes cover fewer domestically produced goods and services but also include some imported (foreign-produced) goods and services.

It should finally be stressed that there is no "right" way of computing real GDP. The economy consists of many goods, each with its own price, and there is no exact way of adding together the production of the different goods. We can say that the BEA's new procedure for computing real GDP avoids the problems associated with the use of fixed weights, and it seems to be an improvement over the old procedure. We will see in the next chapter, however, that the consumer price index (CPI)—a widely used price index—is still computed using fixed weights.

**6.4 LEARNING OBJECTIVE**

Discuss the limitations of using GDP to measure well-being.

# Limitations of the GDP Concept

We generally think of increases in GDP as good. Increasing GDP (or preventing its decrease) is usually considered one of the chief goals of the government's macroeconomic policy. But there are some limitations to the use of GDP as a measure of welfare.

## GDP and Social Welfare MyLab Economics Concept Check

If crime levels went down, society would be better off, but a decrease in crime is not an increase in output and is not reflected in GDP. Neither is an increase in leisure time. Yet to the extent that households want extra leisure time (instead of having it forced on them by a lack of jobs

in the economy), an increase in leisure is also an increase in social welfare. Furthermore, some increases in social welfare are associated with a *decrease* in GDP. An increase in leisure during a time of full employment, for example, leads to a decrease in GDP because less time is spent on producing output.

Most nonmarket and domestic activities, such as housework and child care, are not counted in GDP even though they amount to real production. However, if I decide to send my children to day care or hire someone to clean my house or drive my car for me, GDP increases. The salaries of day care staff, cleaning people, and chauffeurs are counted in GDP, but the time I spend doing the same things is not counted. A mere change of institutional arrangements, even though no more output is being produced, can show up as a change in GDP.

Furthermore, GDP seldom reflects losses or social ills. GDP accounting rules do not adjust for production that pollutes the environment. The more production there is, the larger the GDP, regardless of how much pollution results in the process. GDP also has nothing to say about the distribution of output among individuals in a society. It does not distinguish, for example, between the case in which most output goes to a few people and the case in which output is evenly divided among all people.

## The Informal Economy MyLab Economics Concept Check

Many transactions are missed in the calculation of GDP even though, in principle, they should be counted. Most illegal transactions are missed unless they are "laundered" into legitimate business. Income that is earned but not reported as income for tax purposes is usually missed, although some adjustments are made in the GDP calculations to take misreported income into account. The part of the economy that should be counted in GDP but is not is sometimes called the **informal economy**.

**informal economy** The part of the economy in which transactions take place and in which income is generated that is unreported and therefore not counted in GDP.

## ECONOMICS IN PRACTICE

### An Alternative to GDP: The Human Development Index

GDP and GNI are often used as indicators of economic welfare. However, there is some dissatisfaction with both as measures of a nation's overall well-being. During the second half of the 20th century, debates about the various dimensions of economic development led to the creation, in 1990, of a new indicator—the Human Development Index (HDI). First introduced by the United Nations Development Program, an international development agency, it is now widely used to compare well-being across nations.

Comparing country classifications based on GNI per capita and HDI yields interesting results. While the two are strongly correlated, since the HDI already incorporates the GNI, some high-income countries exhibit lower HDI scores than lower-income countries. Norway, a small high-income country, has consistently topped the HDI chart while having a lower gross national income than other countries such as Singapore or Kuwait. However, it neglects important aspects of a country's well-being, such as human rights or political participation. It also provides only aggregate country-level measures and not the distribution of wellbeing within countries, leading some economists to propose alternatives like a "household-based HDI."[1]

#### CRITICAL THINKING

1. What are the other aspects of a nation's well-being you think are missing from both HDI and GDP (or GNI) measures?

[1]Kenneth Harttgen and Stephan Klasen, "A Household-Based Human Development Index," *Proceedings of the German Development Economics Conference*, Hannover 2010, No. 30.

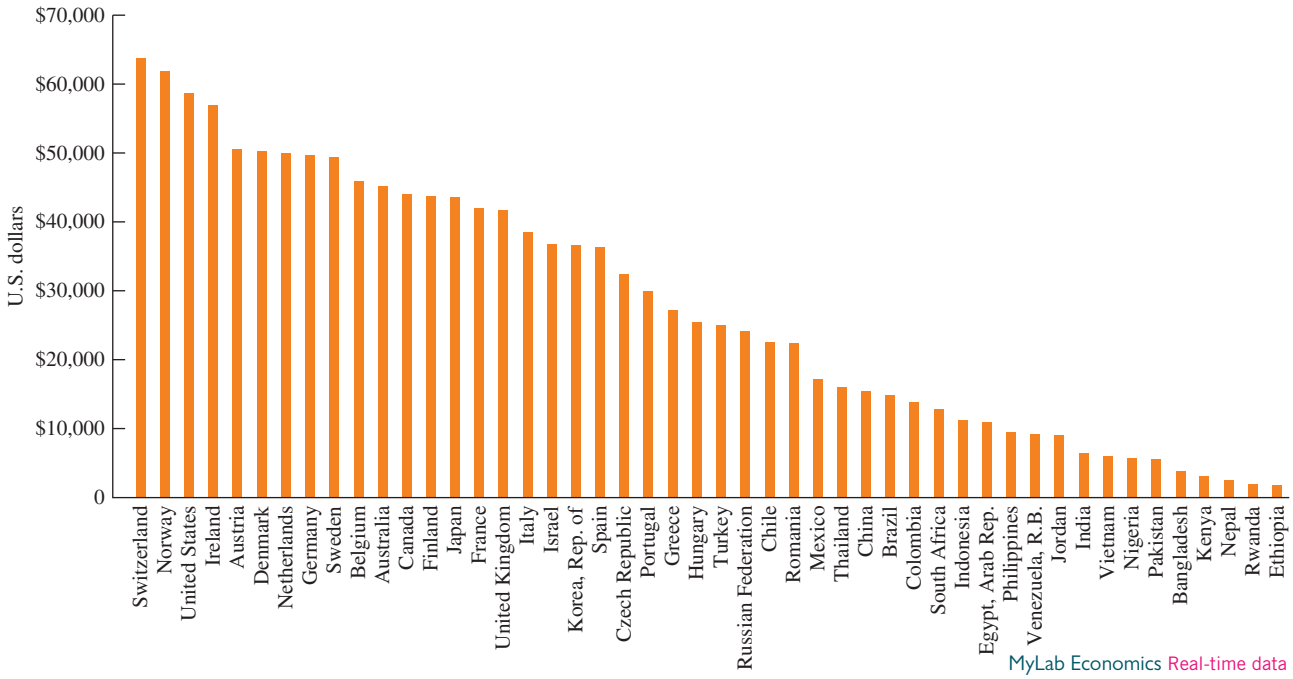
Tax evasion is usually thought to be one of the major incentives for people in developed countries to participate in the informal economy. Studies estimate the size of the U.S. informal economy at about 10 percent, whereas Europe is closer to 20 percent. In the developing world, for a range of reasons, the informal economy is much larger, particularly for women workers. In Latin America and Africa, it is estimated that the informal economy comprises well more than a third of GDP in many nations.[5]

Why should we care about the informal economy? To the extent that GDP reflects only a part of economic activity instead of a complete measure of what the economy produces, it is misleading. Unemployment rates, for example, may be lower than officially measured if people work in the informal economy without reporting this fact to the government. Also, if the size of the informal economy varies among countries—as it does—we can be misled when we compare GDP among countries. For example, Italy's GDP would be much higher if we considered its informal sector as part of the economy, and Switzerland's GDP would change very little.

## Gross National Income per Capita MyLab Economics Concept Check

**gross national income (GNI)** GNP converted into dollars using an average of currency exchange rates over several years adjusted for rates of inflation.

Making comparisons across countries is difficult because such comparisons need to be made in a single currency, generally U.S. dollars. Converting GNP numbers for Japan into dollars requires converting from yen into dollars. Because exchange rates can change quite dramatically in short periods of time, such conversions are tricky. Recently, the World Bank adopted a new measuring system for international comparisons. The concept of **gross national income (GNI)** is GNP converted into dollars using an average of currency exchange rates over several years adjusted for rates of inflation. Figure 6.1 lists the gross national income per capita (GNI divided by population) for various countries in 2016. Of the countries in the figure, Switzerland had the highest per capita GNI, followed by Norway, the United States, and Ireland. Ethiopia was estimated to have per capita GNI of only $1,730 in 2016. This compares to $63,810 for Switzerland.




▲ **FIGURE 6.1 Per Capita Gross National Income for Selected Countries, 2016**

*Source:* Data from GNI per capita, PPP (current international $), The World Bank Group, Retrieved from **http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD**

[5]Jacques Chermes, "The Informal Economy," *Journal of Applied Economic Research*, 2012.