the U.S. economy. BEA releases are eagerly awaited throughout the economy. Top officials at the White House (including the president) find these data so important that they ensure that they get them the night before they are released to the public. Because measuring the economy in a timely and accurate manner is essential for people in financial markets and other lines of business, bond and stock traders in New York, Tokyo, London, and everywhere else keep their eyes glued to their computer terminals when a new government statistic measuring the course of the economy is about to be released. By buying or selling quickly in response to the new information, they can make millions or avoid losing millions.

To economists, measurement of the economy is interesting in its own right, involving clever solutions to intriguing problems. One of the first Nobel Prizes in economics was given to Simon Kuznets for solving some of these measurement problems. As economics students, you cannot help but learn a little about how the economy works when you study how to measure it, just as geology students cannot help but learn a little about earthquakes when they study how the Richter scale measures them. Understanding economic problems, designing possible policy solutions to these problems, and understanding whether the policy solutions did in fact work all require access to reliable data.

The purpose of this chapter is not to train you to work in the BEA. Instead, the goals are to give you a general understanding of what measures the BEA uses, to help you better grasp the strengths and weaknesses of these measures, and to make you more familiar with some key macroeconomic relationships that exist in the economy.

Measuring GDP

To use GDP as a measure of production, we must be precise about what is included in production, where production takes place, and when production takes place.

A Precise Definition of GDP

GDP is a measure of the value of all the newly produced goods and services in a country during some period of time. Let us dissect this definition to determine what is in GDP and what is not, as well as where and when GDP is produced.

- **What?** Both goods—such as automobiles and new houses—and services—such as bus rides or a college education—are included in GDP. However, only newly produced goods and services are included. A ten-year-old baby carriage that is being sold at a garage sale is not included in this year’s GDP; it was included in GDP ten years ago, when it was produced.

- **Where?** Only goods and services produced within the borders of a country are included in that country’s GDP. Goods produced by Americans working in another country are not part of U.S. GDP; they are part of the other country’s GDP. Goods and services produced by foreigners working in the United States are part of U.S. GDP.
• When? Only goods and services produced during some specified period of time are included in GDP. We always need to specify the period during which we are measuring GDP. For example, GDP in 2010 is the production during 2010. GDP for the third quarter of 2010 is the production between July 1 and September 30 of 2010. Rounded off to the nearest billion, GDP, or total production, was $14,660 billion in the United States in 2010. Rounded off to the nearest trillion, GDP was $15 trillion. That is an average production of about $40 billion worth of goods and services a day for each of the 365 days of the year.

Prices Determine the Importance of Goods and Services in GDP

GDP is a single number, but it measures the production of many different things, from apples to oranges, from car insurance to life insurance, from audio CDs to DVDs. How can we add up such different products? Is a CD more important than a DVD? Does a coconut count more toward GDP than a banana does?

Each good is given a weight when we compute GDP, and that weight is its price. If the price of a DVD is greater than that of a CD, then the DVD will count more in GDP. To see this, imagine that production consists entirely of CDs and DVDs. If a DVD costs $15 and a CD costs $10, then producing three DVDs will add $45 to GDP, and producing five CDs will add $50 to GDP. Thus, producing three DVDs plus five CDs adds $95 to GDP, as shown in Table 6-1.

Although this method of weighting by price might not appeal to you personally—you might like CDs more than DVDs—it is hard to imagine anything more workable. In a market system, prices tend to reflect the cost and value of the goods and services produced. One of the great problems of measuring GDP in centrally planned economies such as the former Soviet Union was that the price of goods was set by the government; thus, the weight given each item may have had little to do with either its cost or its value to individuals. Without market prices, measuring GDP in the Soviet Union was difficult.

Intermediate Goods versus Final Goods

When measuring GDP, it is important not to count the same item more than once. Consider bicycle tires. When you buy a $150 bicycle, the tires are considered part of the bicycle. Suppose the tires are worth $20. It would be a mistake to count both the $20 value of the tires and the $150 value of the bicycle, for a total value of $170. That would count the tires twice, which is called double counting. When a tire is part of a new bicycle, it is an example of an intermediate good. Intermediate goods are part of final goods, which by definition are goods that undergo no further processing—in this case, the bicycle. To avoid double counting, we never count intermediate goods; only final goods are part of the GDP. If in a few years you buy a new $25 bicycle tire, then the tire will be a final good.

Table 6-1

Adding Up Unlike Products: CDs and DVDs

<table>
<thead>
<tr>
<th>5 CDs</th>
<th>$10 per CD</th>
<th>$50 of CD production</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 3 DVDs</td>
<td>$15 per DVD</td>
<td>+ $45 of DVD production</td>
</tr>
<tr>
<td>?</td>
<td>?</td>
<td>$95 of CD and DVD production</td>
</tr>
</tbody>
</table>

To add up unlike products... we multiply by their prices to get the dollar value of each... and add together the dollar values of each to get the dollar value of the sum.
Stocks versus Flows  The distinction between \textit{stocks} and \textit{flows} is one of the most useful concepts in economics, and it is especially important in understanding GDP. GDP is a measure of the flow of new goods and services—it measures the value of all the newly produced goods and services in the economy. GDP is not a measure of the stock of goods and services in the economy—it does not tell us the value of all the goods and services that exist in the economy.

For example, the number of new cars produced in the United States during a given time period is a flow measure, while the number of cars in the United States is a stock measure. Therefore, only the former will count toward GDP. Similarly, U.S. GDP for 2010 will count the value of new houses built in the United States in 2010 (a flow measure), but it will not count the value of all homes in the United States (a stock measure).

The economist’s distinction between stocks and flows can be illustrated by picturing water flowing into and out of a lake—for example, the Colorado River flowing into and out of Lake Powell behind Glen Canyon Dam. When more water flows in than flows out, the stock of water in Lake Powell rises. Similarly, a positive flow of inventory investment raises the stock of inventory at a firm. And just as the stock of water falls when more water flows out than flows in, negative inventory investment lowers the stock of inventory.

The distinction between stocks and flows is useful in other economic applications as well. The factories in America on December 31, 2010, are a stock. The number of factories built during 2010 is a flow. The funds in your checking account are a stock. The deposit you made last week is a flow.

Three Ways to Measure GDP  Economists measure GDP in three ways. All three give the same answer, but they refer to conceptually different activities in the economy and provide different ways to think about GDP. All three are reported in the national budget.
income and product accounts, the official U.S. government tabulation of GDP put together by economists and statisticians at the U.S. Department of Commerce’s BEA.

The first way measures the total amount that people spend on goods and services made in the United States. This is the spending approach. The second way measures the total income that is earned by all the workers and businesses that produce American goods and services. This is the income approach. In this approach, your income is a measure of what you produce. The third way measures the total of all the goods and services as they are produced, or as they are shipped out of the factory. This is the production approach. Note that each of the approaches considers the whole economy, and thus we frequently refer to them as aggregate spending, aggregate income, and aggregate production, in which case the word aggregate means total. Let us consider each of the three approaches in turn.

**The Spending Approach**

Typically, total spending in the economy is divided into four components: consumption, investment, government purchases, and net exports, which equal exports minus imports. Each of the four components corresponds closely to one of four groups into which the economy is divided: consumers, businesses, governments, and foreigners. Before considering each component, look at Table 6-2, which shows how the $14,660 billion of GDP in the United States in 2010 was divided into the four categories.

### Table 6-2

<table>
<thead>
<tr>
<th>Components of Spending in 2010 (billions of dollars)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross domestic product (GDP)</td>
<td>$14,660</td>
</tr>
<tr>
<td>Consumption</td>
<td>10,349</td>
</tr>
<tr>
<td>Investment</td>
<td>1,827</td>
</tr>
<tr>
<td>Government purchases</td>
<td>3,000</td>
</tr>
<tr>
<td>Net exports</td>
<td>−516</td>
</tr>
</tbody>
</table>

product—the bicycle, in this case—purchased by consumers. We do not want to count such items twice.

The new machines, factories, and other tools that are part of investment in any year are sometimes called business fixed investment; this amounted to $1,415 billion in 2010. Government statisticians include two other items as part of investment: inventory investment and residential investment.

Inventory investment is defined as the change in inventories, which are the goods on store shelves, on showroom floors, or in warehouses that have not yet been sold or assembled into a final form for sale. For example, cars on the lot of a car dealer are part of inventories. When inventory investment is positive, then inventories are rising. When inventory investment is negative, then inventories are falling.

For example, if a car dealer had an inventory of 50 cars on December 31, 2009, got 35 new cars shipped from the factory during 2010, and sold 20 cars to consumers during the year, then the dealer’s inventory will be 65 cars on December 31, 2010. The contribution of the car dealer to inventory investment for the year is positive 15 cars because the dealer’s inventory rose from 50 cars to 65 cars.

If, instead, the dealer had an inventory of 50 cars on December 31, 2009, got 35 new cars shipped from the factory during 2010, and sold 45 cars to consumers during the year, then the dealer’s inventory will be 40 cars on December 31, 2010. The contribution of the car dealer to inventory investment for the year is negative 10 cars because the dealer’s inventory fell from 50 cars to 40 cars.

Inventory investment is included as a spending item when we compute GDP because we want an accurate measure of production. Consider the first car example again. If we looked only at consumption, then we would have concluded that only 20 cars were produced in the economy, even though 35 cars actually were produced. We need to add the 15 cars of inventory investment to the 20 cars of consumption to get an accurate measure of production.

What happens when consumers eventually purchase the cars that the dealer has in inventory? Suppose, in 2011, consumers buy 25 of the cars that were in the dealer’s inventory. For 2011, consumption will rise by 25 cars, whereas inventory investment will be negative 25 cars, reflecting the fall in the dealer’s inventory. Adding 25 cars of consumption to negative 25 cars of inventory investment gives zero cars added to overall GDP in 2011, which is just what we want because none of these cars were produced in 2011; we already had counted them as production for 2010.

In 2010, inventory investment throughout the economy was $72 billion. Some firms reduced inventories, but others added a greater amount. Inventory investment tends to fluctuate up and down and therefore plays a big role in the business cycle.

The other part of investment that is not business fixed investment is residential investment, the purchase of new houses and apartment buildings. About $340 billion worth of housing and apartments were constructed in 2010. This was a dramatic decline from $757 billion in 2006. Although much of this was purchased by consumers rather than businesses, it is included in investment because it produces services: shelter and, in some cases, a place to relax and enjoy life.

Combining the three parts of investment, we find that investment was $1,827 billion in 2010: $1,415 billion of business fixed investment, $340 billion of residential investment, and $72 billion of inventory investment. Investment was about 12 percent of GDP in 2010 (see Figure 6-2).
Note the special way the term *investment* is used in this discussion. To an economist, investment means the purchase of new factories, houses, or equipment. In everyday language, however, investment usually refers to an individual’s putting away some funds for the future, perhaps in the stock market, such as “I’ll invest in the stock market.” Be sure to stay aware of this distinction.

**Government Purchases** The third component of spending, *government purchases*, is spending by federal, state, and local governments on new goods and services. Most U.S. government purchases are for the military. At the state and local levels, education, roads, and police dominate government purchases. Government purchases of goods and services were equal to $3,000 billion in 2010 (see Figure 6-3).

Not all government outlays are included in government purchases. A government welfare payment or retirement payment to an individual is not a purchase of a good or service; it is a *transfer payment* of income from the government to an individual. Transfer payments do not represent new production of anything, unlike the purchase of a weapon or a new road or a new building. Because GDP measures the production of new goods and services, government outlays on transfer payments like social security, unemployment compensation, and welfare payments are excluded. Only purchases are counted because only these items represent something produced. Government *outlays* are purchases plus transfer payments.

**Net Exports** The final spending component is *net exports*, the difference between exports and imports. American *exports* are what Americans sell to foreigners, whether pharmaceuticals, computers, grain, or a vacation in Florida. American *imports* are what Americans buy from foreigners, whether cars, plasma televisions, shirts, or a vacation in France. Net exports are defined as exports minus imports. Net exports are a measure of how much more we sell to foreigners than we buy from foreigners. Another term for net exports is the *trade balance*. If net exports are positive, we have a trade surplus. If net exports are negative, we have a trade deficit. By these calculations, the United States had a trade deficit in 2010: $1,838 billion in exports and $2,354 billion in imports. Hence, net exports were a negative $516 billion, and appear in Table 6-2 as –$516 billion.
Net exports are added in when computing GDP by the spending approach for two reasons. First, we included foreign goods in consumption and investment spending. For example, an imported Toyota purchased at a car dealer in the United States is included in consumption even though it is not produced in the United States. To measure what is produced in the United States, that Toyota must be deducted. Thus, imports must be subtracted to get a measure of total production in the economy. The second reason is that the exports that Americans sell abroad are produced in the United States, but they are not counted in consumption or investment or government purchases in the United States. Thus, exports need to be added in to get a measure of production. Because, by definition, net exports are exports minus imports, adding net exports to spending is the same as adding in exports and subtracting out imports. Adding net exports to total spending kills two birds with one stone.

In 2010, the United States imported more than it exported, so the sum of consumption plus investment plus government purchases overstated what was produced in America. The sum of these three items exceeds GDP, as shown in Figure 6-3. In other words, GDP was $516 billion less than the sum of consumption plus investment plus government purchases.

**Algebraic Summary** The notion that we can measure production by adding up consumption, investment, government purchases, and net exports is important enough to herald with some algebra.

Let the symbol $C$ stand for consumption, $I$ for investment, $G$ for government spending, and $X$ for net exports. Let $Y$ stand for GDP because we use $G$ for government purchases. We will use these symbols many times again. The idea that production equals spending can then be written as

$$Y = C + I + G + X$$

This equation states, using algebraic symbols, that production, $Y$, equals spending: consumption, $C$, plus investment, $I$, plus government purchases, $G$, plus net exports, $X$ (meaning exports minus imports). In 2010, the values of these items (in billions of dollars) were as follows:

$$14,660 = 10,349 + 1,827 + 3,000 + (-516)$$

This simple algebraic relationship plays a key role in later chapters.

**The Income Approach**

The income that people earn producing GDP in a country provides another measure of GDP. To see why, first consider a simple example of a single business firm.

Suppose you start a wedding planning business. Your production and sales of wedding planning services in your first year is $50,000; this is the amount you are paid in total by 50 people for the $1,000 service. To produce these services, you pay a catering consultant and a florist consultant $20,000 each, or a total of $40,000, which is your total cost. Your profits are defined as the difference between sales and costs, or $50,000 – $40,000 = $10,000. Now, if you add the total amount of income earned in the production of your wedding planning service—the amount earned by the two consultants plus the profits you earn—you get $20,000 + $20,000 + $10,000. This sum of incomes is exactly equal to $50,000, which is the same as the amount produced. Thus, by adding up the income of the people who produce the output of the firm, you get a measure of the output. The same idea is true for the country as a whole, which consists of many such businesses and workers.
To show how this works, we look at each of the income items in Table 6-3. We first describe each of these items and then show that when we add the items up, we get GDP.

**Labor Income** Economists classify wages, salaries, and fringe benefits paid to workers as labor income, or payments to people for their labor. Wages refers to payments to workers paid by the hour; salaries refers to payments to workers paid by the month or year; and fringe benefits refers to retirement, health, and other benefits paid by firms on behalf of workers. As shown in Table 6-3, labor income was $7,991 billion in 2010.

**Capital Income** Economists classify profits, rental payments, and interest payments as capital income. Profits include the profits of large corporations like General Motors or Exxon and also the income of small businesses and farms. The royalties that an independent screenwriter receives from selling a movie script also are part of profits. Rental payments are income to persons who own buildings and rent them out. The rents they receive from their tenants are rental payments. Interest payments are income received from lending to business firms. Interest payments are included in capital income because they represent part of the income generated by the firms’ production. Because many individuals pay interest (on mortgages, car loans, and so on) as well as receive interest (on deposits at a bank and so on), interest payments are defined as the difference between receipts and payments. Table 6-3 shows that capital income was $3,719 billion in 2010, much less than labor income. Capital income is about 45 percent of labor income.

**Depreciation** Depreciation is the amount by which factories and machines wear out each year. A remarkably large part of the investment that is part of GDP each year goes to replace worn-out factories and machines. Businesses need to replace depreciated equipment with investment in new equipment just to maintain productive capacity—the number of factories and machines available for use.

The difference between investment, the purchases of final goods by firms, and depreciation is called net investment, a measure of how much investment is new each year after depreciation is subtracted. Net investment was –$42 billion ($1,827 billion – $1,869 billion) in 2010. This implies that the stock of physical capital actually fell in the United States in 2010. More machines wore out than were added to the economy. Sometimes the $1,827 billion of investment, including depreciation, is called gross investment. The reason for the term gross in gross domestic product is that it includes gross investment, not just net investment.

When profits and the other parts of capital income are reported to government statisticians, depreciation has been subtracted out. But depreciation must be included as part of GDP because the new equipment that replaces old equipment must be produced by someone. Thus, when we use the income approach, it is necessary to add in depreciation if we are to have a measure of GDP.

### Table 6-3

<table>
<thead>
<tr>
<th>Aggregate income</th>
<th>$ 7,991</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor income (wages, salaries, fringe benefits)</td>
<td>$ 7,991</td>
</tr>
<tr>
<td>Capital income (profits, interest, rents)</td>
<td>$ 3,719</td>
</tr>
<tr>
<td>Depreciation</td>
<td>$ 1,869</td>
</tr>
<tr>
<td>Taxes, subsidies, and transfers</td>
<td>$ 1,118</td>
</tr>
<tr>
<td>Net income of foreigners</td>
<td>$ 118</td>
</tr>
<tr>
<td>Statistical discrepancy</td>
<td>$ 151</td>
</tr>
<tr>
<td>Equals GDP</td>
<td>$14,660</td>
</tr>
</tbody>
</table>

Source: U.S. Department of Commerce.
Taxes, Subsidies, and Transfers  When you buy a good, you often will pay a sales tax in addition to the price of the good; sales taxes are collected by businesses and sent directly to the government, either local, state, or federal. For example, the price of gasoline at the pump includes a tax that people who buy gasoline pay as part of the price and that the gasoline station sends to the government. When we tabulate total production by adding up the value of what people spend, we use the prices that businesses charge for a specific good—such as gasoline. That price includes the sales tax that is sent to the government. When we tabulate production by adding up income of consumers and profits of firms, however, the sales tax is not included in firms’ profits. Thus, capital income does not include the sales taxes paid by businesses to the government. But those taxes are part of the income generated in producing GDP; the income happens to go to the government. We therefore must add such taxes to capital and labor income. Similarly, some subsidies from the government to firms are included in profits but do not represent income generated in producing GDP. Subsidies need to be subtracted. Similarly, transfer payments, which are payments between parties that do not involve goods or services being exchanged (for example, a charitable contribution to a museum by a corporation), also need to be removed from calculations because they do not represent income generated in producing GDP. Transfers and subsidies are considerably smaller in magnitude than taxes.

Net Income of Foreigners  Foreigners produce part of the GDP in the United States. Their income, however, is not included in labor income or capital income. For example, the salary of a Canadian hockey player who plays for the Pittsburgh Penguins and keeps his official residence as Canada would not be included in U.S. labor income. But that income represents payment for services produced in the United States and so is part of U.S. GDP. We must add such income payments to foreigners for production in the United States because that production is part of GDP. Moreover, some of the U.S. labor and capital income is earned producing GDP in other countries, and to get a measure of income generated in producing U.S. GDP, we must subtract that amount. For example, the salary of a U.S. baseball player who plays for the Toronto Blue Jays and keeps his official residence as the United States represents payment for services produced in Canada and so is not part of U.S. GDP. We must exclude such income payments for production in other countries. To account for both of these effects, we must add net income earned by foreigners in the United States—that is, the income earned by foreigners in the United States less what Americans earned abroad—to get GDP. [In 2010, Americans earned more abroad ($706 billion) than foreigners earned in the United States ($518 billion); hence, in 2010, net income of foreigners was −$188 billion, as shown in Table 6-3.]

Table 6-3 shows the effects of adding up these five items. The sum is close but not quite equal to GDP. The discrepancy reflects errors made in collecting data on income or spending. This discrepancy has a formal name: the statistical discrepancy. In percentage terms the amount is small, less than 1 percent of GDP, considering the different ways the data on income and spending are collected. If we add in the statistical discrepancy, then we have a measure of aggregate income that equals GDP. From now on we can use the same symbol \(Y\) to refer to GDP and to aggregate income, because GDP and aggregate income amount to the same thing.

The circular flow diagram in Figure 6-4 illustrates the link between aggregate income and aggregate spending. People earn income from producing goods and services, and they spend this income \(Y\) to buy goods and services \(C, I, G,\) and \(X\).
The Production Approach

The third measure of GDP adds up the production of each firm or industry in the economy. To make this method work, we must avoid the “double counting” problem discussed earlier. For example, if you try to compute GDP by adding new automobiles to new steel to new tires, you will count the steel and the tires that go into producing the new automobiles twice. Thus, when we measure GDP by production, it is necessary to count only the value added by each manufacturer. Value added is the value of a firm’s production less the value of the intermediate goods used in production. In other words, it is the value the firm adds to the intermediate inputs to get the final output. An automobile manufacturer buys steel, tires, and other inputs and adds value by assembling the car. When we measure GDP by production, we count only the value added at each level of production. Figure 6-5 shows how adding up the value added for each firm involved in producing a cup of espresso in the economy will automatically avoid double counting and give a measure of the final value of the cup of espresso when it is purchased at a coffeehouse or cafe. The same is true for the economy as a whole.

Figure 6-4

The Circular Flow of Income and Expenditure

This figure illustrates how aggregate expenditures equal aggregate income. Starting at the bottom right part of the figure, consumption \( (C) \) is joined by government purchases \( (G) \), investment \( (I) \), and net exports \( (X) \) to sum to aggregate expenditures \( (C + I + G + X) \) on the left. At the top of the figure, this aggregate spending is received by firms that produce the goods, and they pay out aggregate income \( (Y) \) to households in the form of wages and salaries as well as rents, interest, and profits. The government takes in taxes and makes transfer payments and government purchases.
Value Added in Coffee: From Beans to Espresso

By adding up the value added at each stage of production, from coffee bean growing to espresso making, we get a measure of the value of a cup of espresso. Double counting is avoided. Using the same procedure for the whole economy permits us to compute GDP by adding up production.

**Figure 6-5**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Value Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee grower</td>
<td>Value added by growing and picking beans</td>
</tr>
<tr>
<td></td>
<td>Value of beans</td>
</tr>
<tr>
<td>Coffee roaster</td>
<td>Value added by roasting and packaging</td>
</tr>
<tr>
<td></td>
<td>Value of beans</td>
</tr>
<tr>
<td>Coffee shipper and wholesaler</td>
<td>Value added by shipping and wholesale services</td>
</tr>
<tr>
<td></td>
<td>Value of roasted and packaged beans</td>
</tr>
<tr>
<td></td>
<td>Value of shipped, roasted, and packaged beans</td>
</tr>
<tr>
<td></td>
<td>purchased by a coffee retailer</td>
</tr>
<tr>
<td>Cafe/espresso bar</td>
<td>Value added by espresso machine and service at a cafe</td>
</tr>
<tr>
<td></td>
<td>Value of a cup of espresso ($3.00)</td>
</tr>
</tbody>
</table>

**Review**

- GDP is a measure of all the goods and services newly produced in the economy during some period of time. GDP is a flow measure—how many new goods and services are being produced in the economy. It is not a stock measure—how many goods and services exist in the economy.
- GDP can be measured in three ways: by adding up all the spending in the economy, by adding up all the income in the economy, and by adding up all the production in the economy. All three give the same answer.
- Spending in the economy can be placed in one of four categories—consumption, investment, government purchases, and net exports.
- The sum of labor income; capital income; depreciation; taxes, subsidies, and transfers; and net income paid to foreigners gives another way to measure GDP.
- GDP also can be measured by adding up production, but with this method we must be careful not to double count. By adding up only the value added by each firm or industry, we automatically prevent double counting. Value added is the difference between a firm’s sales and its payments for intermediate inputs to production.
Saving

Another important macroeconomic measure is the total amount of saving undertaken by an economy. Investment and saving have an important symbiotic relationship. To see why this is, consider what would happen if you wanted to build a factory that makes shoes. To build the factory, you would have to either use your own (or a friend or family member’s) saving or borrow money from a bank. But the money that a bank lends to you will be some other individual’s saving. Therefore the total amount of saving is a measure of the amount of resources the country has available for investment, either in its own country or abroad. Similarly, the total amount of investment depends on how much saving is available from that country and from other countries.

Countries with a high level of saving have a greater ability to undertake investment projects than countries with a low level of saving. A country with a low level of saving, however, can increase investment if people and firms in other nations are willing to lend to or invest their own saving in that country. The U.S. economy in recent years has been able to sustain a high level of investment even when U.S. saving was low. In this section, we will define the concept of national saving and show how it is calculated.

Individual Saving

For an individual, saving is defined as income less taxes and consumption. If you earn $25,000 in income during the year and pay taxes of $5,000 while spending $18,000 on consumption—food, rent, and movies, for example—by definition, your saving for the year is $2,000 ($25,000 – $5,000 – $18,000). But if you instead spend $23,000 on food, rent, and movies for the year, then your saving is –$3,000; you will have to either take $3,000 out of the bank or borrow $3,000.

National Saving

For a country, saving is defined in a similar manner: by subtracting from a country’s economy what is consumed. We subtract government purchases of goods and services in addition to consumer purchases. National saving, the sum of all saving in the economy, is defined as income less consumption and government purchases. That is,

$$\text{National saving} = \text{income} - \text{consumption} - \text{government purchases}$$

Using the numbers from Table 6-2, national saving in 2010 was $1,311 billion ($14,660 billion – $10,349 billion – $3,000 billion).

The major component of national saving is private saving: the sum of all savings by individuals in the economy. Some people save a lot, some do not save at all, and some are dissaving—that is, they have negative saving. For example, when people retire, they usually consume a lot more than their income—they are dissaving. When people are middle aged, their income is usually greater than their consumption—they are saving. Most young people either save very little or, if they are able to borrow, dissave. We define private savings using the symbol \( T \) for taxes, as follows:

$$\text{Private saving} = \text{income} - \text{consumption} - \text{taxes}$$

A country, however, also has a government, and so we need to include government saving in our calculation of national saving. What do we mean by saving by the
The difference between the government’s receipts from taxes and the government’s expenditures, the budget balance, is called government saving. When the balance is positive, a budget surplus results—that is, the government is saving. When the balance is negative, a budget deficit results—that is, the government is dissaving. Algebraically, we define government saving as follows:

\[
\text{Government saving} = T - G
\]

Combining private and government saving, we see that

\[
\text{Private saving} + \text{government saving} = \frac{Y}{C} - \frac{C}{C} + \frac{T}{C} - \frac{G}{C} = \frac{Y}{C} - \frac{C}{C} - \frac{G}{C}
\]

Private saving + government saving = national saving

**Measuring Real GDP**

Economists also are interested in assessing how the economy is changing over time. For example, they might want to know how rapidly the production of goods and services in India has grown over the last decade, and how that increase compares with the change in China’s economy. However, the value of goods and services in an economy, as measured by GDP, is determined by both the quantity of goods and services produced and the price of these goods and services. Thus, an increase in the prices of all goods and services will make measured GDP grow, even if the amount of production in the economy does not increase.

Suppose, for example, that the prices of all goods in the economy double and that the number of items produced of every good remains the same. The dollar value of these items then will double even though physical production does not change. A $10,000 car will become a $20,000 car, a $10 CD will become a $20 CD, and so on. Thus, GDP will double as well. Clearly, GDP is not useful for comparing production at different dates when all prices increase. Although the example of doubling all prices is extreme, we do know from Chapter 5 that prices on the average tend to rise over time—a tendency that we have called inflation. Thus, when inflation exists, GDP becomes an unreliable measure of the changes in production over time.

**Adjusting GDP for Inflation**

**Real GDP** is a measure of production that corrects for inflation. To emphasize the difference between GDP and real GDP, we will use the term **nominal GDP** to refer to what previously has been defined as GDP.
Calculating Real GDP Growth  To see how real GDP is calculated, consider an example. Suppose that total production consists entirely of the production of audio CDs and DVDs and that we want to compare total production in two different years: 2008 and 2009.

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th></th>
<th>2009</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Price</td>
<td>Quantity</td>
<td>Price</td>
<td>Quantity</td>
</tr>
<tr>
<td>DVDs</td>
<td>$15</td>
<td>1,000</td>
<td>$20</td>
<td>1,200</td>
</tr>
<tr>
<td>CDs</td>
<td>$10</td>
<td>2,000</td>
<td>$15</td>
<td>2,200</td>
</tr>
</tbody>
</table>

Notice that the number of DVDs produced increases by 20 percent and the number of CDs produced increases by 10 percent from 2008 to 2009. Notice also that the price of DVDs is greater than the price of CDs, but both increase between the two years because of inflation. Nominal GDP is equal to the dollar amount spent on CDs plus the dollar amount spent on DVDs, which is $35,000 in 2008 and $57,000 in 2009, a substantial 63 percent increase.

Nominal GDP in 2008 = $15 \times 1,000 + $10 \times 2,000 = $35,000
Nominal GDP in 2009 = $20 \times 1,200 + $15 \times 2,200 = $57,000

Clearly, nominal GDP is not a good measure of the increase in production: Nominal GDP increases by 63 percent, a much greater increase than the increase in either DVD production (20 percent) or CD production (10 percent). Thus, failing to correct for inflation gives a misleading estimate.

To calculate real GDP, we must use the same price for both years and, thereby, adjust for inflation. That is, the number of CDs and DVDs produced in the two years must be evaluated at the same prices. For example, production could be calculated in both years using 2008 prices. That is,

Using 2008 prices, production in 2008 = $15 \times 1,000 + $10 \times 2,000 = $35,000
Using 2008 prices, production in 2009 = $15 \times 1,200 + $10 \times 2,200 = $40,000

Keeping prices constant at 2008 levels, we see that the increase in production is from $35,000 in 2008 to $40,000 in 2009, an increase of 14.3 percent.

Production, however, also can be calculated in both years using 2009 prices. That is,

Using 2009 prices, production in 2008 = $20 \times 1,000 + $15 \times 2,000 = $50,000
Using 2009 prices, production in 2009 = $20 \times 1,200 + $15 \times 2,200 = $57,000

Keeping prices constant at 2009 levels, we see that the increase in production is from $50,000 in 2008 to $57,000 in 2009, an increase of 14.0 percent.

Observe that the percentage increase in production varies (14.3 percent versus 14 percent) depending on whether 2008 or 2009 prices are used. Such differences are inevitable, because we have no reason to prefer the prices in one year to those of another year when controlling for inflation. Economists arrive at a single percentage by simply averaging the two percentages.¹ In this example, they would conclude that the increase in real GDP from 2008 to 2009 is 14.15 percent, the average of 14.3 percent and 14 percent.

This 14.15 percent increase in real GDP is much lower than the 63 percent increase in nominal GDP and much closer to the actual increase in the number of CDs and tapes produced. By adjusting for inflation in this way, real GDP gives a better picture of the increase in actual production in the economy.

¹ A “geometric” average is used. The geometric average of two numbers is the square root of the product of the two numbers.
A Year-to-Year Chain  This example shows how the growth rate of real GDP between the two years 2008 and 2009 is calculated in the case of two goods. The same approach is used for any other two years and more than two goods. To correct for inflation across more than two years, economists simply do a series of these two-year corrections and then “chain” them together. Each year is a link in the chain. For example, if the growth rate from 2007 to 2008 was 12.15 percent, then chaining this together with the 14.15 percent from 2008 to 2009 would imply an average annual growth rate of 13.15 percent for the two years from 2007 to 2009. That is,

<table>
<thead>
<tr>
<th>Year</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>12.15%</td>
</tr>
<tr>
<td>2008</td>
<td>14.15%</td>
</tr>
<tr>
<td>2009</td>
<td>13.15%</td>
</tr>
</tbody>
</table>

By chaining other years together, link by link, the chain can be made as long as we want.

Obtaining the Values of Real GDP  To obtain real GDP in any one year, we start with a base year and then use the growth rates to compute GDP in another year. The base year is a year in which real GDP is equal to nominal GDP because GDP is valued using that year’s price. Currently, 2005 is the base year for government statistical calculations of GDP in the United States. Thus, real GDP in 2005 and nominal GDP in 2005 are the same: $12,638 billion.

To get real GDP in other years, economists start with the base year and use the real GDP growth rates to find GDP in any other year. Consider 2006. The growth rate of real GDP in 2006—calculated using the methods just described for the entire economy—was 2.7 percent. Thus, real GDP in 2006 was $12,976 billion, or 2.7 percent greater than $12,638 billion. The $12,976 billion is 2006 real GDP measured in 2005 dollars. To emphasize that this number is calculated by chaining years together with growth rates, government statisticians say that real GDP is measured in “chained 2005 dollars.”

Real GDP versus Nominal GDP over Time  Figure 6-6 compares real and nominal GDP from 1990 to 2010. Observe that for the 2005 base year, real GDP and nominal GDP are equal. However, by 2010, real GDP had reached about $13.2 trillion, whereas nominal GDP was at $14.7 trillion. Thus, just as in the example, real GDP increased less than nominal GDP. For the years prior to 2005, real GDP is more than nominal GDP because 2005 prices were higher than prices in earlier years. From Figure 6-6 we can see that nominal GDP would give a misleading picture of the U.S. economy.

The GDP Deflator

Nominal GDP grows faster than real GDP because of inflation. The greater the difference between nominal GDP growth and real GDP growth, the greater the rate of inflation. In the case of deflation, with prices falling, nominal GDP would increase less than real GDP. Hence, a by-product of computing real GDP is a measure of the rate of inflation.

More precisely, if we divide nominal GDP by real GDP, we get the GDP deflator, a measure of the price level, which is the level of all the prices of the items in real GDP. That is,

\[
\text{GDP deflator} = \frac{\text{nominal GDP}}{\text{real GDP}}
\]
Here the GDP deflator is defined so that its value in the base year, such as 2005, is 1.00. (Sometimes it is scaled to equal 100 in the base year by multiplying by 100.)

The reason for the term *deflator* is that to get real GDP, we can deflate nominal GDP by dividing it by the GDP deflator. That is,

\[
\text{Real GDP} = \frac{\text{nominal GDP}}{\text{GDP deflator}}
\]

The percentage change in the GDP deflator from one year to the next is a measure of the rate of inflation.

### Alternative Inflation Measures

The percentage change in the GDP deflator is not the most widely used measure of inflation. A much more frequently cited measure of inflation is based on the percentage change in the *consumer price index (CPI)*, which is the price of a fixed collection—a "market basket"—of consumer goods and services in a given year divided by the price of the same collection in some base year. For example, if the market basket consists of one DVD and two CDs, then the CPI for 2009 compared with the base year 2008 in the previous example would be

\[
\frac{20 \times 1 + 15 \times 2}{15 \times 1 + 10 \times 2} = \frac{50}{35} = 1.43
\]

The CPI inflation rate is the percent change in the CPI; it measures how fast the prices of the items in the basket increase. What are the differences between inflation measured using the CPI and inflation measured using the GDP deflator? The first difference is that the GDP deflator is measuring the price level of all domestically produced goods and services. This includes goods that affect the day-to-day life of consumers, such as the price of milk, the price of orange juice, and the cost of airplane tickets, but it also includes goods that individuals never purchase directly, such as the price of heavy machinery and the price of truck engines. Thus the CPI, as its name suggests, may be a more relevant measure of the price level that consumers care about.

The second difference is that CPI measures the price of a fixed collection of goods and services—the price of the basket—whereas the goods and services that make up
GDP, and hence are measured by the GDP deflator, change from year to year. The use of a fixed collection of goods and services in the CPI is one of the reasons economists think the CPI overstates inflation. When the price of goods rises, the quantity demanded should decline; when the price falls, the quantity demanded should rise. Thus, by not allowing the quantities to change when the price changes, the CPI puts too much weight on items with rising prices and too little weight on items with declining prices. The result is an overstatement of inflation; in other words, by assuming that people buy no less of the goods and services that have increased in price and buy no more of the goods and services that have decreased in price, the CPI tends to indicate that prices have gone up by more than they really have. During the 1990s, a group of economists appointed by the U.S. Senate and chaired by Michael Boskin of Stanford University found that the government, by adjusting expenditures according to this overstated CPI, was spending billions of dollars more than it would with a correct CPI. Hence, getting the economic statistics right makes a big difference.

The third difference between the CPI and the GDP deflator is that the CPI market basket can include goods and services that are produced in other countries, whereas the GDP deflator, by definition, will measure the price of domestically produced goods and services. In countries where imported goods lack good domestic substitutes, inflation measured using the CPI may be a better measure of the difficulties that both people and businesses in the economy face.

Figure 6-7 shows how measures of inflation using the GDP deflator and the CPI compare. The general inflation movements are similar, but the CPI is more volatile. The GDP deflator and the CPI each have strengths and weaknesses relative to the other. So you should think of them as alternative ways of measuring price levels and inflation rates, rather than as competing measurements.

Yet another measure of inflation is the producer price index (PPI), which measures the prices of raw materials and intermediate goods as well as the prices of final goods sold by producers. Prices of raw materials—oil, wheat, and copper—sometimes are watched carefully because they give early warning signs of increases in inflation.

Figure 6-7

Comparison of Measures of Inflation
Measuring inflation with either the CPI or the GDP deflator shows the rise in inflation in the 1960s and 1970s and the lower inflation in the 1980s and 1990s. The CPI is more volatile: It bounces around more. (The inflation rate is based on yearly percent changes in the stated variable.)
Shortcomings of the GDP Measure

Although nominal GDP is the best measure of overall production that we have, it is deficient in several ways. You need to understand what these limitations are, so that you can make informed judgments about what is really happening in the economy. Nominal GDP has three main types of limitations: (1) revisions to GDP can change the assessment of the economy; (2) some types of production are omitted from GDP; and (3) the production of goods and services is only part of what affects the quality of life. When you compare two countries, the one with a higher level of GDP is not necessarily better off than the one with a lower level of GDP.

Revisions to GDP

Government statisticians obtain data on GDP from surveys of stores and businesses, and even from income tax data from the Internal Revenue Service. Not all of these data are collected quickly. Data on sales at stores and large firms come in within a month; however, data on exports and imports take several months. Some income tax data are reported only once a year. Information about small firms comes in even more slowly.

For this reason, the statistics on GDP frequently are revised as new data come in. For those who use the GDP data to make decisions, either in business or in government, faulty data on GDP, which are apparent only when the data are revised, can lead to mistakes. Revisions of GDP are inevitable and occur in all countries. These revisions can be quite large in magnitude. For example, in January 2006, the first estimate for GDP for the fourth quarter of 2005 was given as $12.735 trillion. In March 2006, the “final revision” of that number was given as $12.766 trillion, a difference of almost $30 billion.

Omissions from GDP

Given the description of how GDP is calculated, you will hardly be surprised to hear that production that does not occur in a formal market is difficult for government statisticians to measure. Examples include work done in the home and illegal commerce. The other principal difficulty in calculating GDP is how to deal with quality improvements in goods. Both of these problems are explained in more detail.
**Home Work and Production** Much of the production that people do at home—making dinner or a sweater, changing the car oil or a baby’s diapers, cutting the grass or the kids’ hair—is productive activity, but it is not included in GDP because the transactions are not recorded in the markets in which statisticians measure spending. Such production would be included in GDP if people hired and paid someone else to do any of these things. So if you look after your young siblings after school while your parents are at work, that typically will not count toward GDP, whereas if your parents were to take your siblings to a day-care center and pay for child-care services, that would count toward GDP. Some home production is included in GDP. If you run a mail order or telemarketing business out of your home and pay taxes on your income, for example, then this production likely will be counted in GDP.

**Leisure Activity** Much leisure activity is not included in GDP even though it may be enjoyable. Going to the beach or hiking in the mountains more often and working less might be something you decide to do as your income increases. If people start taking Friday afternoons off, GDP will go down, but the level of well-being may increase. The consumption of leisure is omitted from GDP unless it involves a purchase in the market, such as a ticket to a movie or a ballgame.

**The Underground Economy** A large amount of production is not counted in GDP because it is purposely hidden from the view of the government. Illegal activity—growing marijuana in the California coastal range, selling pharmaceuticals not yet approved by the Food and Drug Administration—is excluded from GDP because no one wants to report this activity to the government. People who get cash payments—perhaps in the form of tips at hotels or restaurants, or babysitting money from a neighbor—may not report this income, perhaps to avoid taxes, and thus it also is not counted. If people do not report interest on a loan to a friend or relative, this, too, is omitted from GDP.

The sum of all the missing items is referred to as the **underground economy**. Estimates of the size of the underground economy are understandably uncertain. They range from about 10 percent of GDP in the United States to about 25 percent in Italy to more than 40 percent in Peru.

The underground economy makes GDP a less useful measure of the size of an economy, and we should be aware of this fact when we use GDP. But the underground economy does not render GDP useless. It is unlikely that the underground economy grows much more or much less rapidly than the rest of the economy. Changes in laws can increase or decrease the incentives to produce outside the legal market economy, but these changes are unlikely to be large enough to affect the estimated growth rates of GDP by much.

**Quality Improvements** Our measure of GDP sometimes misses improvements in the quality of goods and services. For example, a $1,000 notebook computer purchased in 2010 may be of substantially better quality than a $2,000 notebook computer purchased in 2005. So the price of the notebook computer not only has fallen by 50 percent, but in fact the quality-adjusted price also has fallen by even more. Government statisticians, especially in industrial countries like the United States, have developed sophisticated techniques to measure the quality-adjusted price change of a good accurately. These techniques, however, do not always work perfectly, especially when the improvements are in hard-to-measure attributes. So, for example, the government statisticians can look at the amount of memory, the speed of the processor, and the storage capacity of the hard drive to gauge how much the quality of the notebook computer has improved; however, they may not be able to gauge as effectively the quality improvements that make a new model car more comfortable and better able to absorb shocks than the old model.