CHAPTER 7

Taking the Nation's Economic Pulse

It has been said that figures rule the world; maybe. I am quite sure that it is figures which show us whether it is being ruled well or badly.

—Johann Wolfgang Goethe, 1830

Measurement is the making of distinction; precise measurement is making sharp distinctions.

—Enrico Fermi[1]

CHAPTER FOCUS

- What is GDP? How is GDP calculated?
- When making comparisons over time, why is it important to adjust nominal GDP for the effects of inflation?
- What do price indexes measure? How can they be used to adjust for changes in the general level of prices?
- Is GDP a good measure of output? What are its strengths and weaknesses?

[1]As quoted by Milton Friedman in *Economic Freedom: Toward a Theory of Measurement*, edited by Walter Block (Vancouver, British Columbia: The Fraser Institute, 1991), 11.

Our society likes to keep score. The sports pages supply us with the win–loss records that reveal how well the various teams are doing. We also keep score on the performance of our economy. The scoreboard for economic performance is the *national-income accounting system*. Just as a firm's accounting statement provides information on its performance, national-income accounts supply performance information for the entire economy.

Simon Kuznets, the winner of the 1971 Nobel Prize in economics, developed the basic concepts of national-income accounting during the 1920s and 1930s (see the Outstanding Economist feature). Through the years, these procedures have been modified and improved. In this chapter, we will explain how the flow of an economy's output (and income) is measured. We will also explain how changes in the quantity of goods and services produced are separated from changes that reflect merely inflation (higher prices). Finally, we will analyze the strengths and weaknesses of the measurement tools used to assess the performance of our national economy. ■

GDP—A Measure of Output

The **gross domestic product (GDP)** is the market value of final goods and services produced within a country during a specific time period, usually a year. GDP is the most widely used measure of economic performance. The GDP figures are closely watched both by policy makers and by those in the business and financial communities. In the United States, the numbers are prepared quarterly and released a few weeks following the end of each quarter.

Gross domestic product (GDP)

The market value of all final goods and services produced within a country during a specific period.

GDP is a "flow" concept. By analogy, a water gauge measures the amount of water that flows through a pipe each hour. Similarly, GDP measures the market value of production that "flows" through the economy's factories and shops each year (or quarter).

What Counts toward GDP?

First and foremost, GDP is a measure of output. Thus, it cannot be arrived at merely by summing the totals on the nation's cash registers during a period. The key phrases in the definition of GDP—"market value" of "final goods and services" "produced" "within a country" "during a specific time period"—reveal a great deal about what should be included in and excluded from the calculation of GDP. Let's take a closer look at this issue.

ONLY FINAL GOODS AND SERVICES COUNT. If output is to be measured accurately, all goods and services produced during the year must be counted once and only once. Most goods go through several stages of production before they end up in the hands of their ultimate users. To avoid double-counting, one must take care to differentiate between **intermediate goods**—goods in intermediate stages of production—and **final market goods and services**—those purchased for final use rather than for resale or further processing.

Intermediate goods

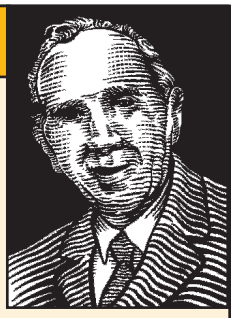
Goods purchased for resale or for use in producing another good or service.

Final market goods and services

Goods and services purchased by their ultimate user.

Sales at intermediate stages of production are not counted by GDP because the value of the intermediate goods is embodied within the final-user good. Adding the sales price of both the intermediate good and the final-user good would exaggerate GDP. For example, when a wholesale distributor sells steak to a restaurant, the final purchase price paid by

OUTSTANDING ECONOMIST



Simon Kuznets (1901–1985)

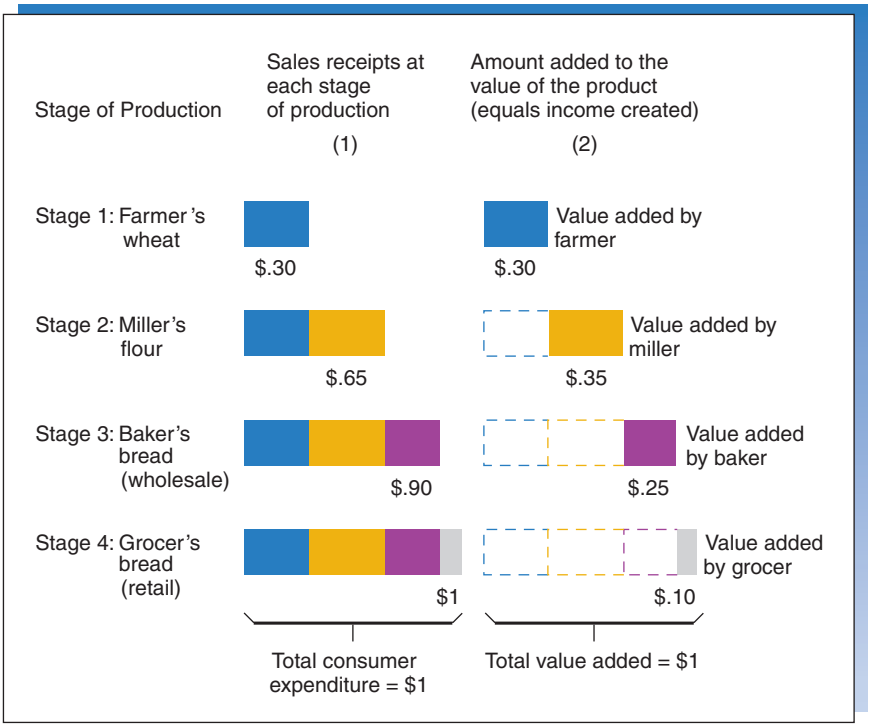
Simon Kuznets provided the methodology for modern national-income accounting and developed the first reliable national-income measures for the United States. Kuznets is often referred to as the "father of national-income accounting." A native Russian, he immigrated to the United States at the age of 21 and spent his academic career teaching at the University of Pennsylvania, Johns Hopkins University, and Harvard University.

the patron of the restaurant for the steak dinner will reflect the cost of the meat. Double-counting would result if we included both the sale price of the intermediate good (the steak sold by the wholesaler to the restaurant) and the final purchase price of the steak dinner.

EXHIBIT 1 will help clarify the accounting method for GDP. Before the final good, bread, is in the hands of the consumer, it will go through several intermediate stages of production. The farmer produces a pound of wheat and sells it to the miller for 30 cents. The miller grinds the wheat into flour and sells it to the baker for 65 cents. The miller's actions have *added* 35 cents to the value of the wheat. The baker combines the flour with other ingredients, makes a loaf of bread, and sells it to the grocer for 90 cents. The baker has *added* 25 cents to the value of the bread. The grocer stocks the bread on the grocery shelves and provides a convenient location for consumers to shop. The grocer sells the loaf of bread for $1, *adding* 10 cents to the value of the final product. Only the final market value of the product—the $1 for the loaf of bread—is included in GDP. This price reflects the value added at each stage of production. The 30 cents *added* by the farmer, the 35 cents by the miller, the 25 cents by the baker, and the 10 cents by the grocer sum to the $1 purchase price.

EXHIBIT 1
GDP and the Stages of Production

Most goods go through several stages of production. This chart illustrates both the market value of a loaf of bread as it passes through the various stages of production (column 1) and the additional value added by each intermediate producer (column 2). GDP counts only the market value of the final product. Of course, the amount added by each intermediate producer (column 2) sums to the market value of the final product.



ONLY TRANSACTIONS INVOLVING PRODUCTION COUNT. Remember, GDP is a measure of goods and services "produced." Financial transactions and income transfers are excluded because they merely move ownership from one party to another. They do not involve current production and are therefore not included in GDP. (*Note*: If a financial transaction involves a sales commission, the commission is included in GDP because it involves a service rendered during the current period.)

Thus, the purchases and sales of stocks, bonds, and U.S. securities are not included in GDP. Neither are private- and public-sector income transfers. If your aunt sends you $100 to help pay for your college expenses, your aunt has less wealth and you have more, but the transaction adds nothing to current production. Government income transfer payments, such as Social Security, welfare, and veterans payments, are also omitted. The recipients of these transfers are not producing goods in return for the transfers. Therefore, it would be inappropriate to add them to GDP.

ONLY PRODUCTION WITHIN THE COUNTRY IS COUNTED. GDP is a measure of "domestic product." Therefore, it counts only goods and services produced within the geographic borders of the country. When foreigners earn income within U.S. borders, it adds to the GDP of the United States. For example, the incomes of Canadian engineers and Mexican baseball players earned in the United States are included in the U.S. GDP. However, the earnings of Americans abroad—for example, an American college professor teaching in England—do not count toward the U.S. GDP because this income is not generated within the borders of the United States.

ONLY GOODS PRODUCED DURING THE CURRENT PERIOD ARE COUNTED. As the definition indicates, GDP is a measure of output "during the current period." Transactions involving the exchange of goods or assets produced during earlier periods are omitted because they do not reflect current production. For example, the purchases of "second-hand" goods, such as a used car or a home built five years ago, are not included in this year's GDP. Production of these goods was counted at the time they were produced and initially purchased. Resale of such items produced during earlier years merely changes the ownership of the goods or assets. It does not add to current production. Thus, these transactions should not be included in current GDP. (*Note:* As in the case of financial transactions, sales commissions earned by those helping to arrange the sale of used cars, homes, or other assets are included in GDP because they reflect services provided during the current period.)

Dollars Are the Common Denominator for GDP

In elementary school, each of us was taught the difficulties of adding apples and oranges. Yet, this is precisely the nature of aggregate output. Literally millions of different commodities and services are produced each year. How can the production of apples, oranges, shoes, movies, roast beef sandwiches, automobiles, dresses, legal services, education, heart transplants, haircuts, and many other items be added together? Answer: The "market value" of each is added to GDP.

The vastly different goods and services produced in our modern world have only one thing in common: Someone pays a price for them. Therefore, when measuring output, units of each good are weighted according to their market value—the purchase price of the good or service. If a consumer pays $25,000 for a new automobile and $25 for a nice meal, production of the automobile adds 1,000 times as much to output as production of the meal. Similarly, production of a television set that is purchased for $1,000 will add 1/25 as much to output as the new automobile and 40 times the amount of the meal.

Each good produced increases output by the amount the purchaser pays for the good. The total spending on all goods and services produced during the year is then summed, in dollar terms, to obtain the annual GDP.

GDP as a Measure of Both Output and Income

There are two ways of looking at and measuring GDP. First, ***the GDP of an economy can be reached by totaling the expenditures on goods and services produced during the year.*** National-income accountants refer to this method as the *expenditure approach*. Alternatively, ***GDP can be calculated by summing the income payments to the resource suppliers of the things used to produce those goods and services.*** Production of goods and services is costly because the resources required for their production must be bid away from their alternative uses. These costs generate incomes for resource suppliers. Thus, this method of calculating GDP is referred to as the *resource cost–income approach*.

The prices used to weight the goods and services included in GDP reflect both the market value of the output and the income generated by the resources. From an accounting viewpoint, when a good is produced and sold, the total payments to the factors of production (including the producer's profit or loss) must be equal to the sales price generated by the good.[2] For example, consider a beauty salon operator who leases a building and equipment, purchases various cosmetic products, and combines these items with labor to provide hairdressing services for which customers pay $500 per day. The market value of the output, $500 per day, is added to GDP. The $500 figure is also equal to the income resource owners receive from the provision of the service.

The link between the market value of a good and the income (including the profit or loss) earned by resource suppliers occurs for each good or service produced. This same link is also present in the aggregate economy. In accounting terms, the idea can be illustrated as follows:

The dollar flow of expenditures on final goods = The dollar flow of income (and indirect cost) from final goods

GDP is a measure of the value of the goods and services that were purchased by households, investors, governments, and foreigners. These purchasers valued the goods and services more than the purchase price; otherwise they would not have purchased them. GDP is also a measure of aggregate income. Production of the goods involves human toil, wear and tear on machines, use of natural resources, risk, managerial responsibilities, and other of life's unpleasantries. Resource owners have to be compensated with income payments in order to induce them to supply these resources.

Thus, GDP is a measure of both (1) the market value of the output produced and (2) the income generated by those who produced the output. This highlights a very important point: Increases in output and growth of income are linked. An expansion in output—that is, the additional production of goods and services that people value—is the source of higher income levels.

EXHIBIT 2 summarizes the components of GDP for both the expenditure and resource cost–income approaches. Except for a few complicating elements that we will discuss in a moment, the revenues business firms derive from the sale of goods and services are paid directly to resource suppliers in the form of wages, self-employment income, rents, profits, and interest. We now turn to an examination of these components and the two alternative ways of deriving GDP.

Deriving GDP by the Expenditure Approach

When derived by the expenditure approach, GDP has four components: (1) personal consumption expenditures, (2) gross private domestic investment, (3) government consumption

[2]In the national-income accounts, the terms profit and corporate profit are used in the accounting sense. Thus, they reflect both the competitive rate of return on assets (opportunity cost of capital) and the firm's economic profit and loss, which were discussed in Chapter 3.

EXHIBIT 2
Two Ways of Measuring GDP

There are two methods of calculating GDP. It can be calculated either by summing the expenditures on the "final-user" goods and services purchased by consumers, investors, governments, and foreigners (net exports) or by summing the income payments and direct cost items that accompany the production of goods and services.

Expenditure Approach	Resource Cost–Income Approach
Personal consumption expenditures	Aggregate income
+	Compensation of employees (wages and salaries)
Gross private domestic investment	Income of self-employed proprietors
+	Rents
Government consumption and gross investment	Profits
+	Interest
Net exports of goods and services	+
=	Nonincome cost items
GDP	Indirect business taxes
	Depreciation
	+
	Net income of foreigners
	=
	GDP

and gross investment, and (4) net exports to foreigners. The left side of **EXHIBIT 3** presents the values of these four components in 2008. Later, we will discuss the right side, which deals with the resource cost–income approach.

CONSUMPTION PURCHASES. **Personal consumption** purchases are the largest component of GDP; in 2008, they amounted to $10,058 billion. Most consumption expenditures are for nondurable goods or services. Food, clothing, recreation, medical and legal services, and fuel are included in this category. These items are used up or consumed in a relatively short time. Durable goods, such as appliances and automobiles, constitute

Personal consumption
Household spending on consumer goods and services during the current period. Consumption is a flow concept.

EXHIBIT 3
Two Ways of Measuring GDP—2008 Data (billions of dollars)

The left side shows the flow of expenditures and the right side the flow of income payments and indirect costs. Both procedures yield GDP.

Expenditure Approach			Resource Cost–Income Approach	
Personal Consumption		$10,058	Employee Compensation	$8,055
Durable goods	$1,023		Proprietors' Income	$1,072
Nondurable goods	$2,965		Rents	$64
Services	$6,070		Corporate Profits	$1,477
Gross Private Investment		$1,994	Interest Income	$683
Fixed Investment	$2,041		Indirect Business Taxes	$1,080
Inventories	−$47		Depreciation (Capital Consumption)[a]	$1,967
Gov. Cons. and Gross Inv.		$2,882	Net Income of Foreigners	−$133
Federal	$1,072			$14,265
State and local	$1,810			
Net Exports		−$669		
Gross Domestic Product		$14,265	Gross Domestic Product	$14,265

[a]Includes $1,523 billion for the depreciation of privately owned capital, $308 billion for the depreciation of government-owned assets, and plus $136 billion for statistical discrepancy.

Source: U.S. Department of Commerce. These data are also online at http://www.bea.gov.

approximately one-ninth of all consumer purchases. These products are consumed over a longer period of time, even though they are fully counted when they are purchased.

Private investment

The flow of private-sector expenditures on durable assets (fixed investment) plus the addition to inventories (inventory investment) during a period. These expenditures enhance our ability to provide consumer benefits in the future.

Depreciation

The estimated amount of physical capital (for example, machines and buildings) that is worn out or used up producing goods during a period.

GROSS PRIVATE INVESTMENT. The next item in the expenditure approach, **private investment**, is the production or construction of capital goods that provide a "flow" of future service. Unlike food or medical services, they are not immediately "used." Business plants and equipment are investment goods because they will help produce goods and services in the future. Similarly, a house is an investment good because it will also provide a stream of services long into the future. Increases in business inventories are also classified as investment because they will provide future consumer benefits.

Gross investment includes expenditures for both (1) the replacement of machinery, equipment, and buildings worn out during the year and (2) net additions to the stock of capital assets. Net investment is simply gross investment minus an allowance for **depreciation** and obsolescence of machinery and other physical assets during the year.

Net investment is an important indicator of the economy's future productive capability. A substantial amount of net investment indicates that the capital stock of the economy is growing, thereby enhancing the economy's future productive potential (shifting the economy's production possibilities frontier outward). In contrast, a low rate of net investment, or even worse, a negative net investment, implies a stagnating or even contracting economy. Of course, the impact of investment on future income will also be affected by the productivity of investment—whether the funds invested are channeled into wealth-creating projects. Other things being the same, however, countries with a large net investment rate will tend to grow more rapidly than those with a low (or negative) rate of net investment. In 2008, gross private investment expenditures in the United States were $1,994 billion, 14.0 percent of GDP. Of course, a large portion ($1,967 billion) of this figure was for the replacement of private assets worn out during the year. Thus, net private investment was $161 billion, only 1.1 percent of GDP.

Inventory investment

Changes in the stock of unsold goods and raw materials held during a period.

Because GDP is designed to measure current production, allowance must be made for goods produced but not sold during the year—that is, for **inventory investment**, or changes during the year in the market value of unsold goods on shelves and in warehouses. If business firms have more goods on hand at the end of the year than they had at the beginning of the year, inventory investment will be positive. This inventory investment must be added to GDP. Conversely, a decline in inventories would indicate that the purchases of goods and services exceeded current production. In this case, inventory *disinvestment* would be a subtraction from GDP. In 2008, the United States disinvested $47 billion in additional inventories.

GOVERNMENT CONSUMPTION AND GROSS INVESTMENT. In 2008, federal, state, and local government consumption and investment in the United States summed to $2,882 billion, approximately 20 percent of total GDP. The purchases of state and local governments exceeded those of the federal government by a wide margin. The government component includes both (1) expenditures on items like office supplies, law enforcement, and the operation of veterans hospitals, which are "consumed" during the current period, and (2) the purchase of long-lasting capital goods, like missiles, highways, and dams for flood control. (Remember, transfer payments are excluded from GDP because they do not involve current production.) As a result, the government's total expenditures are substantially higher than its total consumption and investment expenditures. Unlike the other components of GDP, government purchases are counted at their *cost* to taxpayers rather than their *value* to those receiving them. In cases in which the value of the item to citizens is low relative to the tax cost of providing it, the government expenditures will overstate the value derived from the item.

Net exports

Exports minus imports.

Exports

Goods and services produced domestically but sold to foreigners.

Imports

Goods and services produced by foreigners but purchased by domestic consumers, businesses, and governments.

NET EXPORTS. The final item in the expenditure approach is **net exports**, or total exports minus imports. **Exports** are domestically produced goods and services sold to foreigners. **Imports** are foreign-produced goods and services purchased domestically.

Remember, GDP is a measure of domestic production—output produced within the borders of a nation. Therefore, when measuring GDP by the expenditure approach, we must (1) add exports (goods produced domestically that were sold to foreigners) and (2) subtract imports (goods produced abroad that were purchased by Americans). For national-income accounting purposes, we can combine these two factors into a single entry:

Net exports = Total exports − Total imports

Net exports may be either positive or negative. When we sell more to foreigners than we buy from them, net exports are positive. In recent years, however, net exports have been negative, indicating we were buying more goods and services from foreigners than we were selling to them. In 2008, net exports were *minus* $669 billion.

Deriving GDP by the Resource Cost–Income Approach

The right side of Exhibit 3 illustrates how, rather than summing the flow of expenditures on final goods and services, we could reach GDP by summing the flow of costs incurred and income generated. Labor services play a very important role in the production process. It is therefore not surprising that employee compensation, $8,055 billion in 2008, provides the largest source of income generated by the production of goods and services.

Self-employed proprietors undertake the risks of owning their own business and simultaneously provide their own labor services to their firm. Their earnings in 2008 contributed $1,072 billion to GDP, 7.5 percent of the total. Together, employees and self-employed proprietors accounted for approximately two-thirds of GDP.

Machines, buildings, land, and other physical assets also contribute to the production process. Rents, corporate profits, and interest are payments to people who provide either the physical resources or the financial resources required for the purchase of physical assets. Rents are returns to resource owners who permit others to use their assets during a time period. Corporate profits are earned by stockholders, who bear the risk of the business undertaking and provide the financial capital the firm needs to purchase resources. Interest is a payment to parties who extend loans to producers.

Not all cost components of GDP result in an income payment to a resource supplier. In order to get to GDP, we also need to account for three other factors: indirect business taxes, the cost of depreciation, and the net income of foreigners.

INDIRECT BUSINESS TAXES. Taxes imposed on the sale of a good that increase the cost of the good to consumers are called **indirect business taxes**. The sales tax is a clear example. When you make a $1.00 purchase in a state with a 5 percent sales tax, the purchase actually costs you $1.05. The $1.00 goes to the seller to pay wages, rent, interest, and managerial costs. The 5 cents goes to the government. Indirect business taxes boost the market price of goods when GDP is calculated by the expenditure approach. Similarly, when looked at from the factor-cost viewpoint, taxes are an indirect cost of supplying the goods to the final consumers.

Indirect business taxes
Taxes that increase a business firm's costs of production and, therefore, the prices charged to consumers. Examples are sales, excise, and property taxes.

DEPRECIATION. As machines are used to produce goods, they wear out and become less valuable. Even though this decline in the value of capital assets is a cost of producing goods during the current period, it does not involve a direct payment to a resource owner. Thus, it must be estimated. Depreciation is an estimate, based on the expected life of the asset, of the decline in the asset's value during the year. In 2008, depreciation (sometimes called *capital consumption allowance*) of private- and public-sector capital amounted to $1,968 billion, approximately 13.8 percent of GDP.

National income
The total income earned by a country's nationals (citizens) during a period. It is the sum of employee compensation, self-employment income, rents, interest, and corporate profits.

NET INCOME OF FOREIGNERS. The sum of employee compensation, proprietors' income, rents, corporate profits, and interest yields **national income**, the income of Americans, whether earned domestically or abroad. If depreciation and indirect business

Gross national product (GNP)

The total market value of all final goods and services produced by the citizens of a country. It is equal to GDP minus the net income of foreigners.

Net income of foreigners

The income that foreigners earn by contributing labor and capital resources to the production of goods within the borders of a country minus the income the nationals of the country earn abroad.

taxes—the two indirect cost components—are added to national income, the result will be **gross national product (GNP)**, the output of Americans, whether generated in the United States or abroad. Put another way, GNP counts the income that Americans earn abroad, but it omits the income foreigners earn in the United States.

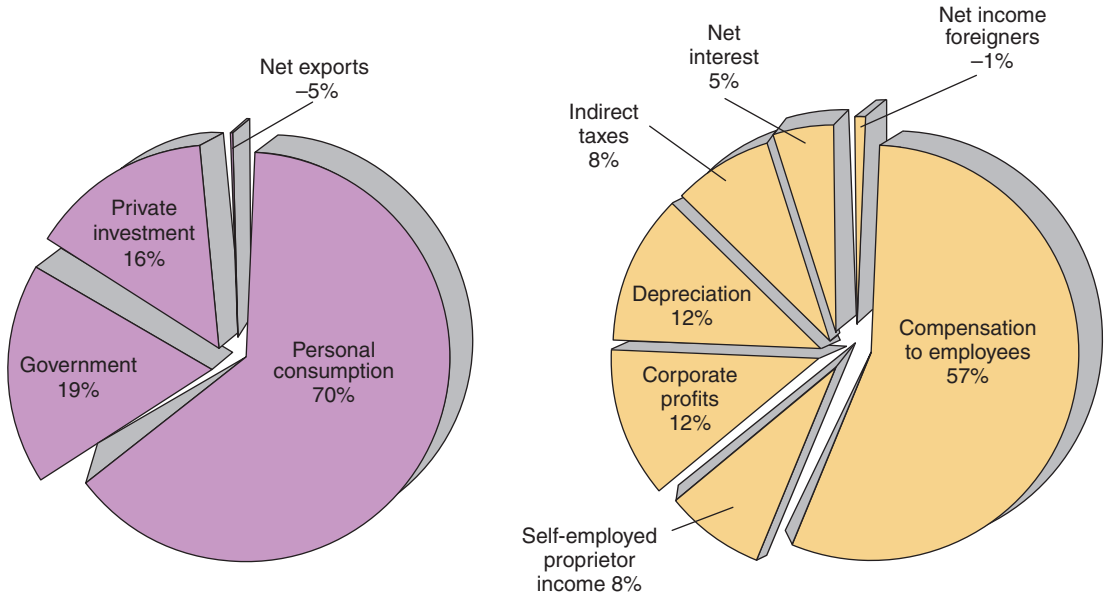
Because GDP is a measure of domestic output, the net income earned by foreigners must be added when GDP is derived using the resource cost-income approach. The **net income of foreigners** is equal to the income foreigners earn in the United States minus the income that Americans earn abroad. If Americans earn more abroad than foreigners earn in the United States, the net income of foreigners will be negative. In recent years, this has been the case. The net income of foreigners is generally small. In 2008, it was *minus* $133 billion, about 1 percent of GDP. As Exhibit 3 indicates, when this figure is added to the other components, the sum is equal to GDP.

The Relative Size of GDP Components

EXHIBIT 4 shows the relative size of each of the GDP components during 2005–2008. When the expenditure approach is used, personal consumption is by far the largest component of GDP. Consumption accounted for 70 percent of GDP during 2005–2008, compared with only 16 and 19 percent for private investment and government purchases, respectively. When GDP is measured using the resource cost–income approach, compensation to employees is the dominant component (57 percent of GDP). During 2005–2008, corporate profits and interest combined accounted for 17 percent of GDP.

EXHIBIT 4
The Major Components of GDP in the United States, 2005–2008

The relative sizes of the major components of GDP usually fluctuate within a fairly narrow range. The average proportion of each component during 2005–2008 is demonstrated here for both (a) the expenditure and (b) the resource cost–income approaches.



[a]Rental income was negligible.
Numbers may not add up to 100 percent due to rounding.
Source: http://www.economagic.com.

Adjusting for Price Changes and Deriving Real GDP

GDP was developed to help us better assess what is happening to output (and income) over time. This is important because expansion in the production of goods and services people value is the source of higher incomes and living standards. When comparing GDP across time periods, however, we confront a problem; the nominal value of GDP may increase as the result of either (1) an expansion in the quantity of goods produced or (2) higher prices. Because only the former will improve our living standards, it is very important to distinguish between the two.

When tracking the path of GDP and other income measures across time periods, economists use price indexes to adjust **nominal values** (or *money values*, as they are often called) for the effects of inflation—an increase in the general level of prices over time. When the term **real** accompanies GDP and income data (for example, *real GDP* or *real wages*), this means that the data have been adjusted for changes in the general level of prices through time. When comparing data at different points in time, it is nearly always the real changes that are of most interest.

Nominal values

Values expressed in current dollars.

Real values

Values that have been adjusted for the effects of inflation.

What precisely is a price index, and how can it be used to adjust GDP and other figures for the effects of inflation? A price index measures the cost of purchasing a market basket (or "bundle") of goods at a point in time relative to the cost of purchasing the identical market basket during an earlier reference period. A base year (or period) is chosen and assigned a value of 100. As prices increase and the cost of purchasing the reference bundle of goods rises relative to the base year, the price index increases proportionally. Thus, a price index of 110 indicates that the general level of prices is 10 percent higher than during the base period. An index of 120 implies 20 percent higher prices than the base period, and so on. *Note*: See the Addendum at the end of this chapter for additional details on how price indexes are constructed.

Two Key Price Indexes: The Consumer Price Index and the GDP Deflator

Price indexes indicate what is happening to the general level of prices. The two most widely used are the consumer price index (CPI) and the GDP deflator. Because the construction of the CPI is simpler, we will begin with it.

The* consumer price index (CPI) *is designed to measure the impact of price changes on the cost of the typical bundle of goods purchased by households. A bundle of 211 items that constitute the "typical bundle" purchased by urban consumers during the 1982–1984 base period provides the foundation for the CPI. The quantity of each good reflects the quantity actually purchased by the typical household during the base period. Every month, the Bureau of Labor Statistics surveys approximately 26,400 stores representative of the urban United States to derive the average price for each of the food items, consumer goods and services, housing, and property taxes included in the index. The cost of purchasing this 211-item market basket at current prices is then compared with the cost of purchasing the same market basket at base-year prices. The result is a measure of current prices compared with 1982–1984 base-period prices. In 2008, the value of the CPI was 215.3, compared with 100 during the 1982–1984 base period. This indicates that the price level in 2008 was 115.3 percent higher than the price level of 1982–1984.

Consumer price index (CPI)

An indicator of the general level of prices. It attempts to compare the cost of purchasing the market basket bought by a typical consumer during a specific period with the cost of purchasing the same market basket during an earlier period.

The* GDP deflator *is a broader price index than the CPI. It is designed to measure the change in the average price of the market basket of goods included in GDP. In addition to consumer goods, the GDP deflator includes prices for capital goods and other goods and services purchased by businesses and governments. Therefore, in addition to consumer goods, the bundle used to construct the GDP deflator will include such items as large computers, airplanes, welding equipment, and office space. The overall bundle is intended to be representative of those items included in GDP.

GDP deflator

A price index that reveals the cost during the current period of purchasing the items included in GDP relative to the cost during a base year (currently 2000). Unlike the consumer price index (CPI), the GDP deflator also measures the prices of capital goods and other goods and services purchased by businesses and governments. Because of this, it is thought to be a more accurate measure of changes in the general level of prices than the CPI.

The cost of purchasing the typical bundle of goods included in this year's GDP is always compared with the cost of purchasing that same bundle at last year's prices. Each year's percentage change in prices, based on the updated bundle, is then used to chain together the index. Because of this constant updating of the typical bundle, the impact of price increases is reduced when purchasers substitute away from goods that have risen in price. As a result, the GDP deflator is thought to yield a slightly more accurate measure of changes in the general level of prices than the CPI. As in the case of the CPI, a base year (currently it is the year 2000) is chosen for the GDP deflator and assigned a value of 100. Values of the GDP deflator above 100 indicate that the general level of prices is higher than during the base period.

The annual inflation rate is simply the percentage change from one year to the next in the general level of prices. Both the CPI and the GDP deflator can be used to estimate the rate of **inflation**. When using either price index (PI):

Inflation

An increase in the general level of prices of goods and services. The purchasing power of the monetary unit, such as the dollar, declines when inflation is present.

$$\textbf{Inflation rate} = \frac{\textbf{This year's PI} - \textbf{Last year's PI}}{\textbf{Last year's PI}} \times 100$$

If the price index this year was 220, compared with 200 last year, for example, the inflation rate would equal 10 percent:

$$\frac{220 - 200}{200} \times 100 = 10$$

EXHIBIT 5 presents data during 1983–2008 for both the CPI and GDP deflator and uses each to estimate the annual rate of inflation. Even though the two price indexes are based on different market baskets and procedures, their estimates for the annual rate of inflation

EXHIBIT 5
The Consumer Price Index and GDP Deflator: 1983–2008

Year	CPI (1982–84 = 100)	Inflation Rate (%)	GDP Deflator (2000 = 100)	Inflation Rate (%)
1983	99.6	3.2	65.2	4.0
1984	103.9	4.3	67.7	3.8
1985	107.6	3.6	69.7	3.0
1986	109.6	1.9	71.3	2.2
1987	113.6	3.6	73.2	2.7
1988	118.3	4.1	75.7	3.4
1989	124.0	4.8	78.6	3.8
1990	130.7	5.4	81.6	3.9
1991	136.2	4.2	84.4	3.5
1992	140.3	3.0	86.4	2.3
1993	144.5	3.0	88.4	2.3
1994	148.2	2.6	90.3	2.1
1995	152.4	2.8	92.1	2.0
1996	156.9	3.0	93.9	1.9
1997	160.5	2.3	95.4	1.7
1998	163.0	1.5	96.5	1.1
1999	166.6	2.2	97.9	1.4
2000	172.2	3.4	100.0	2.2
2001	177.1	2.8	102.4	2.4
2002	179.9	1.6	104.2	1.7
2003	184.0	2.3	106.4	2.1
2004	188.9	2.7	109.5	2.9
2005	195.3	3.4	113.0	3.3
2006	201.6	3.2	116.7	3.2
2007	207.3	2.8	119.8	2.7
2008	215.3	3.8	122.4	2.2

Source: http://www.economagic.com.

are similar. The difference between the two alternative measures is usually only a few tenths of a percentage point.

The CPI and GDP deflator were designed for different purposes. Choosing between the two depends on what we are trying to measure. If we want to determine how rising prices affect the money income of consumers, the CPI would be most appropriate because it includes only consumer goods. However, if we want an economy-wide measure of inflation with which to adjust GDP data, the GDP deflator is clearly the appropriate index because it includes a broader set of goods and services.

Using the GDP Deflator to Derive Real GDP

We can use the GDP deflator together with **nominal GDP** to measure **real GDP**, which is GDP in dollars of constant purchasing power. If prices are rising, we simply deflate the nominal GDP during the latter period to account for the effects of inflation.

Nominal GDP
GDP expressed at current prices. It is often called money GDP.

Real GDP
GDP adjusted for changes in the price level.

EXHIBIT 6 illustrates how real GDP is measured and why it is important to adjust for price changes. Between 2000 and 2008, the nominal GDP of the United States increased from $9,817 billion to $14,265 billion, an increase of 45.3 percent. However, a large portion of this increase in nominal GDP reflected inflation rather than an increase in real output. When making GDP comparisons across time periods, we generally do so in terms of the purchasing power of the dollar during the base year of the GDP deflator, currently 2000. The GDP deflator, the price index that measures changes in the cost of all goods included in GDP, increased from 100.0 in 2000 to 122.4 in 2008. This indicates that prices rose by 22.4 percent between 2000 and 2008. To determine the real GDP for 2008 in terms of 2000 dollars, we deflate the 2008 nominal GDP for the rise in prices:

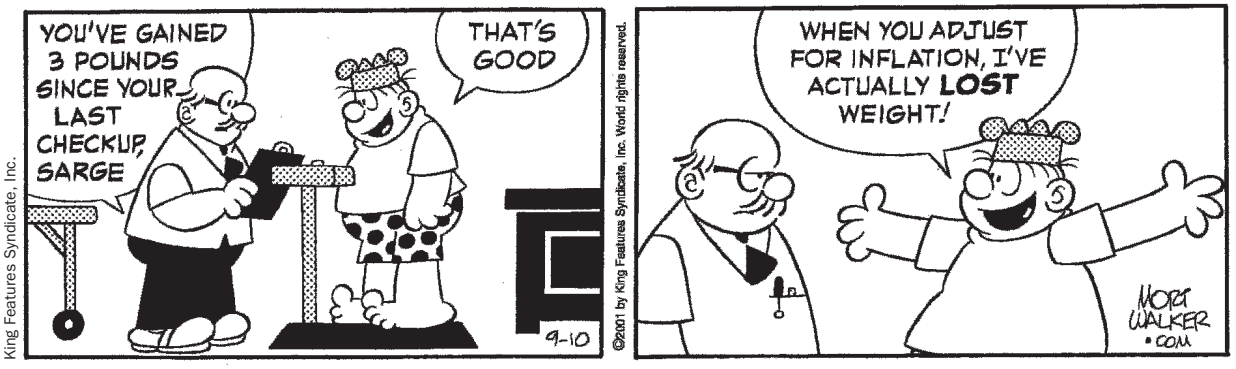
$$\textbf{Real GDP}_{2008} = \textbf{Nominal GDP}_{2008} \times \frac{\textbf{GDP deflator}_{2000}}{\textbf{GDP deflator}_{2008}}$$

EXHIBIT 6
Changes in Prices and Real GDP in the United States, 2000–2008

Between 2000 and 2008, nominal GDP increased by 45.3 percent. But when the 2008 GDP is deflated to account for price increases, we see that real GDP increased by only 18.7 percent.

	Nominal GDP (billions of dollars)	Price Index (GDP deflator, 2000 = 100)	Real GDP (billions of 2000 dollars)
2000	$9,817	100.0	$9,817
2008	14,265	122.4	11,654
Percentage Increase	45.3	22.4	18.7

Source: http://www.economagic.com.



APPLICATIONS IN ECONOMICS

Converting Prior Data to Current Dollars: The Case of Gasoline

We have explained how the GDP deflator can be used to convert nominal GDP data to real GDP (measured in terms of the dollar's purchasing power during the base year of the GDP deflator). Sometimes, however, it makes more sense to convert income or other data during prior years to the purchasing power of the dollar during the current year. A price index can also be used to accomplish this task. To convert an earlier observation to current dollars, just multiply the observation by the price index during the current period and then divide it by the price index during the earlier period. If prices have risen in recent years, this will "inflate" the data for the earlier year and thereby bring it into line with the current purchasing power of the dollar.

Let's illustrate this point and at the same time analyze the changes in gasoline prices during the last several decades. As gas prices rose sharply during 2007, the media reported that they had risen to an all-time high in the United States. In nominal terms, this was indeed the case, but what about the real price of gasoline?

The accompanying table presents data for the nominal price (column 1) of a gallon of unleaded regular gasoline for various years since 1973. The parallel data for the consumer price index (CPI) are presented in column 2. The nominal price of gasoline in 1973 was 39 cents. To convert this figure to the purchasing power of the dollar in April 2009, multiply the 39 cents by the ratio of the CPI in April 2009 divided by the CPI in 1973. This real price (shown in column 3), measured in terms of the 2009 price level, is equal to $1.87 (0.39 times the ratio of 212.7/44.4).

Both crude oil prices and gasoline prices rose sharply throughout the 1970s. By 1980, the nominal price of gasoline had risen to $1.25. This would make the real price of gasoline measured in 2009 dollars equal to $3.23 ($1.25 times the ratio of 212.7/82.4), even higher than the price in 2009. What was the real price of gasoline in 1976, 1985, 1990, 1995, and 2005? As an exercise, derive these figures to make sure that you understand how to convert data from an earlier time period into the purchasing power of the dollar during the current year.

Price of a Gallon of Regular Unleaded Gasoline

Year	Nominal Price (1)	CPI (1982–84 = 100) (2)	Real Price (3)
1973	$0.39	44.4	$1.87
1976	0.61	56.9	?
1980	1.25	82.4	3.23
1985	1.20	107.6	?
1990	1.16	130.7	?
1995	1.15	152.4	?
2000	1.51	172.2	1.87
2005	2.30	195.3	?
2009 (April)	2.31	212.7	2.31

Source: U.S. Energy Information Administration, *Monthly Energy Review*. The data for regular unleaded gasoline were unavailable prior to 1976. Thus, the 1973 observation is for regular leaded gasoline, which was slightly cheaper during that period.

Because prices were rising, the latter ratio is less than 1. Measured in terms of 2000 dollars, the real GDP in 2008 was $11,654 billion, only 18.7 percent more than in 2000. So although money GDP (nominal GDP) expanded by 45.3 percent, real GDP increased by only 18.7 percent.

Data on both money GDP and price changes are essential for meaningful output comparisons between two time periods. By itself, a change in money GDP tells us nothing about what is happening to the rate of real production. For example, not even a doubling of money GDP would lead to an increase in real output if prices more than doubled during the time period. On the other hand, money income could remain constant while real GDP increased if there were a reduction in prices. Knowledge of both nominal GDP and the general level of prices is required for real income comparisons over time.

Problems with GDP as a Measuring Rod

Even real GDP is an imperfect measure of current output and income. Some productive activities are omitted because their value is difficult to determine. The introduction of new products complicates the use of GDP as a measuring rod. Also, when production involves

harmful side effects that are not fully registered in the market prices, GDP will fail to measure the level of output accurately. Let's take a closer look at some of the limitations of GDP.

Nonmarket Production

GDP does not count household production because it does not involve a market transaction. As a result, the household services of millions of people are excluded. If you mow the yard, repair your car, paint your house, pick up relatives from school, or perform similar productive household activities, your efforts add nothing to GDP because no market transaction is involved. Such nonmarket productive activities are sizable—10 percent to 15 percent of total GDP.

Excluding household production results in some oddities in national-income accounting. Suppose, for example, that a woman marries her gardener, and, after the marriage, the spouse-gardener works for love rather than for money. GDP will decline because the services of the spouse-gardener no longer involve a market transaction and therefore no longer contribute to GDP. In contrast, if a family member decides to enter the labor force and hires someone to perform services previously provided by household members, there will be a double-barreled impact on GDP. It will rise as a result of (1) the market earnings of the new labor-force entrant plus (2) the amount paid to the person hired to perform the services that were previously supplied within the household.

Most important, omitting household production makes income comparisons across lengthy time periods less meaningful. Compared with the situation today, fifty years ago Americans were far more likely to produce sizable amounts of their own food and clothing. Only a small proportion of married women worked, and child care services were almost exclusively provided within the household. Today, people are also more likely to eat out at a restaurant than prepare their own food; hire a lawn service than mow their own lawn; and purchase an automatic dishwasher than do the dishes by hand. These and many other similar changes involve the substitution of a market transaction, which adds to GDP. Because the share of total production provided within the household has declined relative to production that involves market transactions, current GDP, even in real dollars, is overstated relative to the earlier period. Correspondingly, this factor causes an upward bias to the growth rate of real GDP.

Underground Economy

Some people attempt to conceal various economic activities in order to evade taxes or because the activities themselves are illegal. Economists call these activities, which are unreported and therefore difficult to measure, the **underground economy**.

Underground economy

Unreported barter and cash transactions that take place outside recorded market channels. Some are otherwise legal activities undertaken to evade taxes. Others involve illegal activities, such as trafficking drugs and prostitution.

Because cash transactions are hard for government authorities to trace, they are the lifeblood of the underground economy. This is why drug trafficking, smuggling, prostitution, and other illegal activities are generally conducted in cash. Not all underground economic activity is illegal. A large portion of the underground economy involves legal goods and services that go unreported so that people can try to evade taxes. The participants in this legal-if-reported portion of the underground economy are quite diverse. Taxicab drivers and wait staff may pocket fees and tips. Small-business owners may fail to ring up and report various cash sales. Craft and professional workers may fail to report cash income. Employees ranging from laborers to bartenders may work "off the books" and accept payment in cash in order to qualify for income-transfer benefits or evade taxes (or allow their employers to evade taxes).

Even though they are often productive, these unreported underground activities are not included in GDP. Estimates of the size of the underground economy in the United States range from 10 percent to 15 percent of total output. The available evidence indicates that the size of the underground economy is even larger in Western Europe (where tax rates are higher) and South America (where regulations often make it more costly to operate a business legally).

Leisure and Human Costs

GDP excludes leisure and the human cost associated with the production of goods and services. Only output matters; no allowance is made for how long or how hard people work to generate it. Simon Kuznets, the "inventor" of GDP, believed that these omissions substantially reduced the accuracy of GDP as a measure of economic well-being.

The average number of hours worked per week in the United States has declined through the years. The average nonagricultural production worker spent only 33.3 hours per week on the job in 2008, compared with more than 40 hours in 1947—a 15 percent reduction in weekly hours worked. Clearly, this reduction in the length of the workweek raised the American standard of living, even though it did not enhance GDP.

GDP also fails to take into account human costs. On average, jobs today are less physically strenuous and are generally performed in a safer, more comfortable environment than they were a generation ago.[3] To the extent that working conditions have improved through the years, GDP figures understate the growth of real income.

Quality Variation and the Introduction of New Goods

If GDP is going to measure accurately changes in real output, changes in the price level must be measured accurately. This is a difficult task in a dynamic world where new and improved products are constantly replacing old ones. Think about how much more functional today's computers are compared with yesterday's typewriters, for example. Even after adjusting for inflation, today's personal computer probably costs more than the typewriter of 1980. But there is also a huge difference between the quality of the two products. Thus, a portion of the higher price of improved products like computers is due to quality improvements rather than pure inflation. Although statisticians attempt to make some allowance for quality improvements and new products, they are generally thought to be inadequate. Most economists believe that price indexes, including the GDP deflator, overestimate the rate of inflation by approximately 1 percent *annually* because quality improvements aren't accounted for accurately. If so, annual changes in output are underestimated by a similar amount. Although 1 percent per year might seem small, errors of this size make a huge difference over long time periods.

Harmful Side Effects and Economic "Bads"

GDP makes no adjustment for harmful side effects that sometimes arise from production, consumption, and the destructive acts of man and nature. If they do not involve market transactions, economic "bads" are ignored in the calculation of GDP. Yet, in a modern industrial economy, production and consumption sometimes generate side effects that either detract from current consumption or reduce our future production possibilities. When property rights are defined imperfectly, air and water pollution are sometimes side effects of economic activity. For example, an industrial plant may pollute the air or water while producing goods. Automobiles may put harmful chemicals into the atmosphere while providing us with transportation. GDP makes no allowance for these negative side effects. In fact, expenditures on the cleanup of air and water pollution, should they be undertaken, will add to GDP.

Similarly, GDP makes no allowance for various acts of destruction. Consider the impact of the September 11, 2001, terrorist attacks. In addition to roughly 3,000 fatalities, property losses were estimated at approximately $20 billion, including the destruction of the World Trade Center, portions of the Pentagon, and the four commercial planes hijacked. But GDP makes no allowance for these losses. Therefore, none of this destruction influenced GDP. In fact, the cleanup cost, which continued for months, actually added

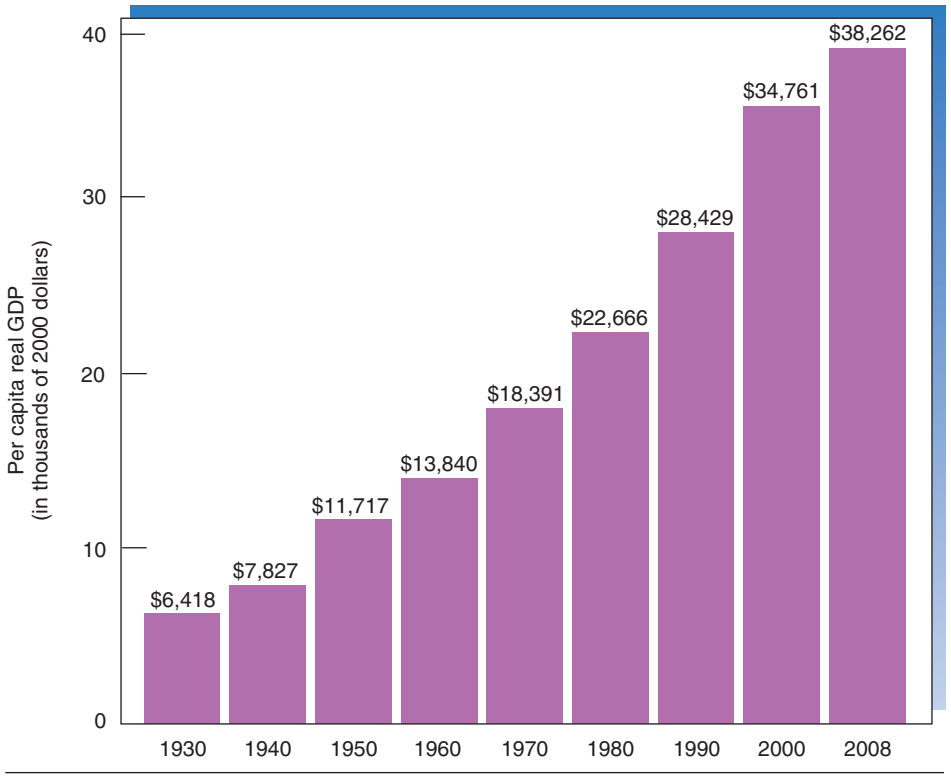
[3]For evidence on this point, see "Have a Nice Day," *2001 Annual Report, Federal Reserve Bank of Dallas* (available online at http://www.dallasfed.org).

to GDP. Of course, GDP was indirectly adversely affected by the attacks: some people and businesses weren't able to function for some time afterward, if ever. Air travel and tourism spending fell. Other responses to the attacks, like the increase in expenditures on security, national defense, and the reconstruction of the Pentagon, enhanced GDP. But the GDP numbers did not reflect the loss of property or life. The same is true for destruction accompanying hurricanes, earthquakes, and other acts of nature. Even if billions of dollars of assets are destroyed, there will be no adjustment made to the GDP numbers.

Differences in GDP over Time

Per capita GDP is simply GDP divided by population. It is a measure of income per person or the average level of income. As real per capita GDP increases, so too does the average level of real income. **EXHIBIT 7** presents the data for per capita real GDP (measured in 2000 dollars) for the United States for various years since 1930. In 2008, per capita GDP was more than twice the figure of 1970 and six times the figure for 1930. What do these figures reveal? As we previously discussed, some of the measurement deficiencies of GDP will result in an overstatement of current real GDP relative to earlier periods. For example, current per capita GDP is biased upward because, compared with earlier periods, more output now takes place in the market sector and less in the household sector. Other biases, however, are in the opposite direction. Reductions in both time and strenuousness of work as well as the introduction of improved products and new technologies provide examples of the latter. On balance, the direction of the overall bias is uncertain.

However, one thing is clear: GDP comparisons are less meaningful when there is a dramatic difference in the bundle of goods available. This is generally the case when comparisons are made across distant time periods. Consider the 1930s, compared with today. In the 1930s, there were no jet planes, television programs, automatic dishwashers,



Source: Derived from U.S. Department of Commerce data.

EXHIBIT 7
Per Capita GDP: 1930–2008

In 2008, per capita real GDP was 2.8 times the 1960 level, 4.9 times the 1940 level, and 6.0 times the 1930 level. What do these numbers reveal about income today relative to the earlier years?

personal computers, or MP3 players. In 1930, even a millionaire could not have purchased the typical bundle consumed by the average American in 2006.[4] When the potential goods available differ substantially between time periods (or countries), comparative GDP statistics lose some of their precision.

Shortcomings aside, however, there is evidence that GDP per person is a broad indicator of general living standards. As per capita GDP in the United States has increased over time, the quality of most goods has increased while the amount of work time required for their purchase has declined. In many cases, the changes have been dramatic. (See the boxed feature, "The Time Cost of Goods: Today and Yesterday.") Like per capita GDP, these data indicate that our income levels and living standards have improved. Various quality-of-life variables paint a similar picture. For example, as per capita GDP has risen in the United States and other countries, life expectancy and leisure time have gone up, while illiteracy and infant mortality rates have gone down. This suggests that increases in per capita GDP and improvements in living standards are closely related.

APPLICATIONS IN ECONOMICS

The Time Cost of Goods: Today and Yesterday

Many of you have heard stories from your parents or grandparents about how low prices were when they were young. A bottle of soda cost only a nickel, and a brand-new car was less than $2,000. In this chapter, you have learned that there is a difference between nominal and real values. Economists generally use the CPI or GDP deflator to adjust the nominal prices of earlier periods and figure out if a good is now cheaper or more expensive. There is, however, an alternative way of looking at this issue: you could estimate how long a person working at the average wage rate would have to work in order to earn enough to purchase various items at different points in time. For example, just after telling you that a soda used to cost a nickel, your grandfather might have noted that he used to earn only 25 cents per hour. Thus, for an hour's worth of work, he could earn enough money to purchase five bottles of soda. Today, the price of a soda is approximately $1. To earn the same real wage as your grandfather, you would need to earn only $5 per hour (exactly enough to purchase five sodas with your hour's wage).

Over time, the productivity of the average worker in America has increased substantially. This increased worker productivity is the key to higher real incomes and improved living standards. When people are able to produce more per hour of work, they will be able to achieve a higher living standard.

Using average wage rates, W. Michael Cox and Richard Alm of the Federal Reserve Bank of Dallas have computed the time of work required for the typical worker to purchase many common items. Their analysis shows that Americans today are able to acquire most goods with much less work time than was previously the case. Some examples are shown in the accompanying table.

In 1908, a new automobile cost $850, which took the average worker 4,696 hours to earn. In 1955, a new automobile costing $3,030 took 1,638 hours of work, and by 1997, a $17,995 new automobile cost a typical worker only 1,365 hours of work. The time cost of a new car today is less than 30 percent of the time cost in 1908. Furthermore, even today's most economical model is light–years away from the 1908 version with regard to power, performance, and dependability.

The prices of technology products, such as computers, calculators, and cellular phones, in particular, have fallen dramatically in recent years. Cellular phones and computers now cost only a small fraction of the time required for their purchase just a few years ago. In 1984, it took the average worker more than 10 weeks of work to purchase a cellular phone; by 1997, the work time cost had fallen to 9 hours, and the figure is still lower today. In 1901, spending on food, clothing, and shelter consumed 76 percent of the typical worker's paycheck. Because of greater productivity and higher real earnings, today the average worker spends only 38 percent of earnings on these items.

[4]The following quotation from the late Mancur Olson, longtime professor of economics at the University of Maryland, illustrates this point:

> The price level has risen about eight times since 1932, so a $25,000 income then would be the "equivalent" of an income of $200,000 today—one could readily afford a Rolls-Royce, the best seats in the theater, and the care of the best physicians in the country. But the 1932 Rolls-Royce, for all its many virtues, does not embody some desirable technologies available today in the humblest Ford. Nor would the imposing dollar of 1932 buy a TV set or a home videocassette recorder. And if one got an infection, the best physicians in 1932 would not be able to prescribe an antibiotic.

APPLICATIONS IN ECONOMICS

As worker productivity grows, real incomes increase, and the time cost required to purchase products falls. This process generates higher living standards and brings goods that used to be luxuries, costing weeks' or months' worth of a worker's salary, within the reach of most Americans. The next time you call home, remind your parents that in 1915, a 3-minute, coast-to-coast, long distance telephone call cost more than 2 weeks' worth of wages. Today, it costs only 1.8 minutes of work. Your parents will be happy to hear that, particularly if you are calling collect.

The Cost of Products to an Average-Wage Worker in Minutes or Hours of Work

Item	Old Cost	Cost in 1997
Eggs (1 dozen)	80 minutes in 1919	5 minutes
Sugar (5 lbs.)	72 minutes in 1919	10 minutes
Coffee (1 lb.)	55 minutes in 1919	17 minutes
Bread (1 lb.)	13 minutes in 1919	4 minutes
Mattress and box spring (twin)	161 hours in 1929	24 hours
Refrigerator	3,162 hours in 1916	68 hours
Clothes washer and dryer	256 hours in 1956	52 hours
Automobile	4,696 hours in 1908	1,365 hours
Coast-to-coast air flight	366 hours in 1930	16 hours
Big Mac	27 minutes in 1940	9 minutes
Long-distance call (3 min.)	90 hours in 1915	1.8 minutes
Calculator	31 hours in 1972	46 minutes
Microwave oven	97 hours in 1975	15 hours
Cellular phone	456 hours in 1984	9 hours
Personal computer	435 hours in 1984	76 hours

Source: W. Michael Cox and Richard Alm, "Time Well Spent: The Declining Real Cost of Living in America," *1997 Annual Report, Federal Reserve Bank of Dallas:* 2–24. Also see Michael Cox, *Myths of Rich and Poor* (New York: Basic Books, 1999).

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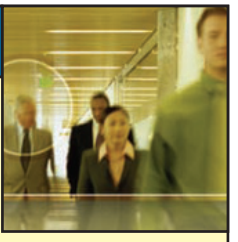
Is an automobile really more expensive now than it was in 1955? You might be surprised to learn that in 1955 it took a typical worker 1,638 hours of work time to purchase a car. Today, a vastly improved model can be purchased after only 1,365 hours of work.

The Great Contribution of GDP

Although GDP is a broad indicator of income levels and living standards, this is not its major purpose. ***GDP was designed to measure the value of the goods and services produced during a time period. In spite of its limitations, real GDP is a reasonably precise measure of the rate of output and the year-to-year changes in that output***.

Adjusted for changes in prices, annual and quarterly GDP data provide the information required to track the economy's performance level. These data allow us to compare the current rate of output with that of the recent past. Without this information, policy makers would be less likely to adopt productive policies, and business decision makers would be less able to determine the future direction of the demand for their products.

Looking ahead



GDP provides us with a measure of economic performance. In the next chapter, we will take a closer look at the path of real GDP in the United States and introduce other indicators of economic performance. Later, we will investigate the factors that underlie both the level of and fluctuations in real GDP.

KEY POINTS

- Gross domestic product (GDP) is a measure of the market value of final goods and services produced within the borders of a country during a specific time period, usually a year.
- Income transfers, purely financial transactions, and exchanges of goods and assets produced during earlier periods are not included in GDP because they do not involve current production.
- When derived by the expenditure approach, GDP has four major components: (1) personal consumption, (2) gross private investment, (3) government consumption and gross investment, and (4) net exports.
- When derived by the resource cost–income approach, GDP equals (1) the direct income components (wages and salaries, self-employment income, rents, interest, and corporate profits), plus (2) indirect business taxes, depreciation, and the net income of foreigners.
- Price indexes measure changes in the general level of prices over time. They can be used to adjust nominal values for the effects of inflation. The two most widely used price indexes are the GDP deflator and the consumer price index (CPI).
- The following formula can be used to convert the nominal GDP data of the current period (2) to real GDP measured in terms of the general level of prices of an earlier period (1):

$$\text{Real GDP}_2 = \text{Nominal GDP}_2 \times \frac{\text{GDP deflator}_1}{\text{GDP deflator}_2}$$

- Even real GDP is an imperfect measure of current production. It excludes household production and the underground economy, fails to take leisure and human costs into account, and adjusts imperfectly for quality changes.
- Real GDP is vitally important because it is a reasonably accurate measure of how well the economy is doing. Per capita GDP is a broad indicator of income levels and living standards across time periods.