CHAPTER
23

Measuring a Nation's Income

When you finish school and start looking for a full-time job, your experience will, to a large extent, be shaped by prevailing economic conditions. In some years, firms throughout the economy are expanding their production of goods and services, employment is rising, and jobs are easy to find. In other years, firms are cutting back production, employment is declining, and jobs are hard to find. Not surprisingly, any college graduate would rather enter the labor force in a year of economic expansion than in a year of economic contraction.

Because the health of the overall economy profoundly affects all of us, changes in economic conditions are widely reported by the media. Indeed, it is hard to pick up a newspaper, check an online news service, or turn on the TV without seeing some newly reported economic statistic. The statistic might measure the total income of everyone in the economy (gross domestic product), the rate at which average prices are rising or falling (inflation/deflation), the percentage of the labor force that is out of work (unemployment), total spending at stores (retail sales), or the imbalance of trade between the

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United States and the rest of the world (the trade deficit). All these statistics are *macroeconomic*. Rather than telling us about a particular household, firm, or market, they tell us something about the entire economy.

microeconomics
the study of how households and firms make decisions and how they interact in markets

macroeconomics
the study of economy-wide phenomena, including inflation, unemployment, and economic growth

As you may recall from Chapter 2, economics is divided into two branches: microeconomics and macroeconomics. **Microeconomics** is the study of how individual households and firms make decisions and how they interact with one another in markets. **Macroeconomics** is the study of the economy as a whole. The goal of macroeconomics is to explain the economic changes that affect many households, firms, and markets simultaneously. Macroeconomists address a broad variety of questions: Why is average income high in some countries and low in others? Why are prices sometimes rapidly rising and other times more stable? Why do production and employment expand in some years and contract in others? What, if anything, can the government do to promote rapid growth in incomes, low inflation, and stable employment? These questions are all macroeconomic in nature because they concern the workings of the entire economy.

Because the economy as a whole is a collection of many households and many firms interacting in many markets, microeconomics and macroeconomics are closely linked. The tools of supply and demand, for instance, are as central to macroeconomic analysis as they are to microeconomic analysis. Yet studying the economy in its entirety raises some new and intriguing challenges.

In this and the next chapter, we discuss some of the data that economists and policymakers use to monitor the performance of the overall economy. These data reflect the economic changes that macroeconomists try to explain. This chapter considers *gross domestic product* (GDP), which measures the total income of a nation. GDP is the most closely watched economic statistic because it is thought to be the single best measure of a society's economic well-being.

23-1 The Economy's Income and Expenditure

If you were to judge how a person is doing economically, you might first look at her income. A person with a high income can more easily afford life's necessities and luxuries. It is no surprise that people with higher incomes enjoy higher standards of living—larger houses, better healthcare, fancier cars, more opulent vacations, and so on.

The same logic applies to a nation's overall economy. When judging whether the economy is doing well or poorly, it is natural to look at the aggregate income that everyone in the economy is earning. Gross domestic product allows us to do just that.

GDP measures two things at once: the total income of everyone in the economy and the total expenditure on the economy's output of goods and services. GDP can perform the trick of measuring both total income and total expenditure because these two things are the same. *For an economy as a whole, income must equal expenditure.*

Why is this true? An economy's income equals its expenditure because every transaction has two parties: a buyer and a seller. Every dollar of spending by some buyer is a dollar of income for some seller. Suppose, for instance, that Karen pays Doug $100 to mow her lawn. In this case, Doug is a seller of a service and Karen is a buyer. Doug earns $100 and Karen spends $100. Thus, the transaction contributes equally to the economy's income and to its expenditure. GDP, whether measured as total income or total expenditure, rises by $100.

Another way to see the equality of income and expenditure is with the circular-flow diagram in Figure 1. As you may recall from Chapter 2, this diagram describes all the transactions between households and firms in a simple economy. It simplifies matters by assuming that all goods and services are bought by households and that households spend all of their income. In this economy, when households buy goods and services from firms, these expenditures flow through the markets for goods and services. When the firms use the money they receive from sales to pay workers' wages, landowners' rent, and firm owners' profit, this income flows through the markets for the factors of production. Money continuously flows from households to firms and then back to households.

GDP measures this flow of money. We can compute it for this economy in either of two ways: by adding up the total expenditure by households or by adding up the total income (wages, rent, and profit) paid by firms. Because all expenditure in the economy ends up as someone's income, GDP is the same regardless of how we compute it.

The actual economy is, of course, more complicated than the one illustrated in Figure 1. Households do not spend all of their income; they pay some of it to the government in taxes, and they save some for use in the future. In addition, households do not buy all goods and services produced in the economy; some goods and services are bought by governments, and some are bought by firms that plan to use them in the future to produce their own output. Yet the basic lesson remains the same: Regardless of whether a household, government, or firm buys a good or service, the transaction always has a buyer and a seller. Thus, for the economy as a whole, expenditure and income are the same.

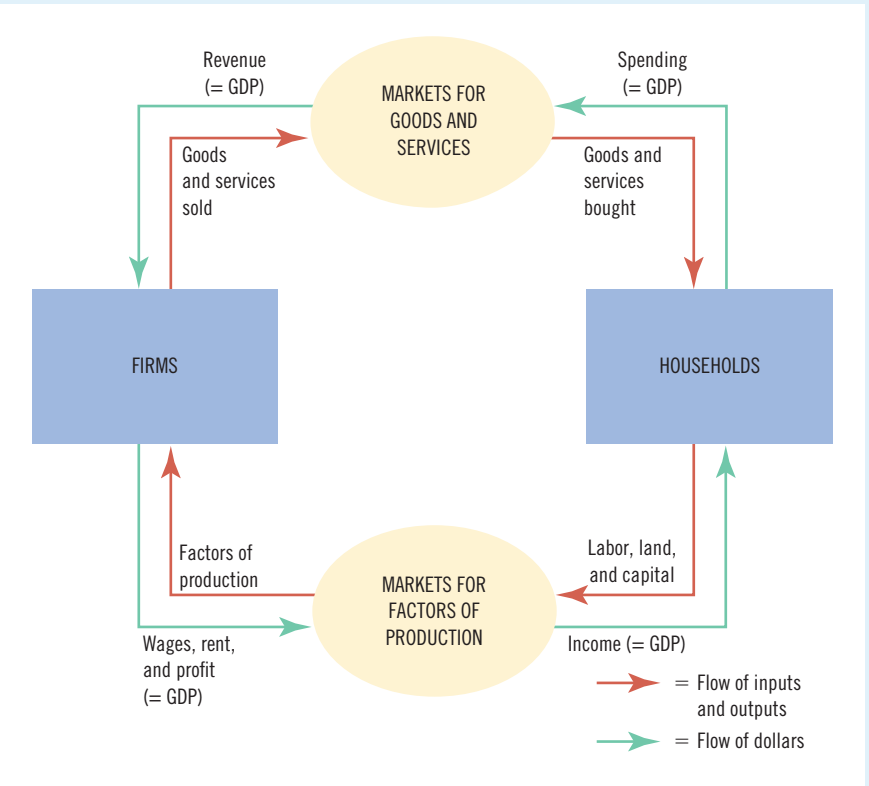


FIGURE 1

The Circular-Flow Diagram
Households buy goods and services from firms, and firms use their revenue from sales to pay wages to workers, rent to landowners, and profit to firm owners. GDP equals the total amount spent by households in the market for goods and services. It also equals the total wages, rent, and profit paid by firms in the markets for the factors of production.

QuickQuiz

1. An economy's gross domestic product is
   a. the excess of spending over income.
   b. the excess of income over spending.
   c. total income and total spending.
   d. total income times total spending.

2. Sam bakes a cake and sells it to Carla for $10. Woody pays Diane $30 to tutor him. In this economy, GDP is
   a. $10.
   b. $20.
   c. $30.
   d. $40.

Answers at end of chapter.

23-2 The Measurement of GDP

Having discussed the meaning of gross domestic product in general terms, let's be more precise about how this statistic is measured. Here is a definition of GDP that focuses on GDP as a measure of total expenditure:

gross domestic product (GDP)
the market value of all final goods and services produced within a country in a given period of time

- **Gross domestic product (GDP)** is the market value of all final goods and services produced within a country in a given period of time.

This definition might seem simple enough. But in fact, many subtle issues arise when computing an economy's GDP. Let's therefore consider each phrase in this definition with some care.

23-2a "GDP Is the Market Value . . ."

You have probably heard the adage "You can't compare apples and oranges." Yet GDP does exactly that. GDP adds together many different kinds of products into a single measure of the value of economic activity. To do this, it uses market prices. Because market prices measure the amount people are willing to pay for different goods, they reflect the value of those goods. If the price of an apple is twice the price of an orange, then an apple contributes twice as much to GDP as does an orange.

23-2b ". . . of All . . ."

GDP tries to be comprehensive. It includes all items produced in the economy and sold legally in markets. GDP measures the market value of not just apples and oranges but also pears and grapefruit, books and movies, haircuts and healthcare, and on and on.

GDP also includes the market value of the housing services provided by the economy's stock of housing. For rental housing, this value is easy to calculate—the rent equals both the tenant's expenditure and the landlord's income. Yet many people own their homes and, therefore, do not pay rent. The government includes this owner-occupied housing in GDP by estimating its rental value. In effect, GDP is based on the assumption that the owner is renting the house to herself. The imputed rent is included both in the homeowner's expenditure and in her income, so it adds to GDP.

Some products, however, are excluded from GDP because they are hard to measure. GDP excludes most items produced and sold illicitly, such as illegal drugs. It also excludes most items that are produced and consumed at home and, therefore, never enter the marketplace. For instance, GDP includes vegetables you buy at the grocery store but not vegetables you grow in your garden.

These exclusions from GDP can at times lead to paradoxical results. For example, when Karen pays Doug to mow her lawn, that transaction is part of GDP.

But suppose Doug and Karen get married. Even though Doug may continue to mow Karen's lawn, the value of the mowing is now left out of GDP because Doug's service is no longer sold in a market. Thus, their marriage reduces GDP.

23-2c ". . . Final . . ."

When International Paper makes paper, which Hallmark then uses to make a greeting card, the paper is called an *intermediate good* and the card is called a *final good*. GDP includes only the value of final goods because the value of intermediate goods is already included in the prices of the final goods. Adding the market value of the paper to the market value of the card would be double counting. That is, it would (incorrectly) count the paper twice.

An important exception to this principle arises when an intermediate good is produced and, rather than being used, is added to a firm's inventory of goods for use or sale at a later date. In this case, the intermediate good is taken to be "final" for the moment, and its value as inventory investment is included as part of GDP. Thus, additions to inventory add to GDP, and when the goods in inventory are later used or sold, the reductions in inventory subtract from GDP.

23-2d ". . . Goods and Services . . ."

GDP includes both tangible goods (food, clothing, cars) and intangible services (haircuts, housecleaning, doctor visits). When you buy a CD by your favorite band, you are buying a good, and the purchase price is part of GDP. When you pay to hear a concert by the same band, you are buying a service, and the ticket price is also part of GDP.

23-2e ". . . Produced . . ."

GDP includes goods and services currently produced. It does not include transactions involving items produced in the past. When Ford produces and sells a new car, the value of the car is included in GDP. But when one person sells a used car to another person, the value of the used car is not included in GDP.

23-2f ". . . Within a Country . . ."

GDP measures the value of production within the geographic confines of a country. When a Canadian citizen works temporarily in the United States, her production counts toward U.S. GDP. When an American citizen owns a factory in Haiti, the production at her factory does not contribute to U.S. GDP. (It contributes to Haiti's GDP.) Thus, items are included in a nation's GDP if they are produced domestically, regardless of the nationality of the producer.

23-2g ". . . In a Given Period of Time."

GDP measures the value of production that takes place within a specific interval of time. Usually, that interval is a year or a quarter (three months). GDP measures the economy's flow of income, as well as its flow of expenditure, during that interval.

When the government reports the GDP for a quarter, it usually presents GDP "at an annual rate." This means that the figure reported for quarterly GDP is the amount of income and expenditure during the quarter multiplied by four. The government uses this convention so that quarterly and annual figures on GDP can be compared more easily.

In addition, when the government reports quarterly GDP, it presents the data after they have been modified by a statistical procedure called *seasonal adjustment*. The unadjusted data show that the economy produces more goods and services during some times of the year than during others. (As you might guess,

December's holiday shopping season is a high point.) When monitoring the economy, economists and policymakers often want to look beyond these regular seasonal changes. Therefore, government statisticians adjust the quarterly data to take out the seasonal cycle. The GDP data reported in the news are always seasonally adjusted.

Now let's repeat the definition of GDP:

- Gross domestic product (GDP) is the market value of all final goods and services produced within a country in a given period of time.

This definition focuses on GDP as total expenditure in the economy. But recall that every dollar spent by a buyer of a good or service becomes a dollar of income to the seller of that good or service. Therefore, in addition to adding up total expenditure in the economy to calculate GDP, the government also adds up total income in the economy to arrive at *gross domestic income* (GDI). GDP and GDI give almost exactly the same number. (Why "almost"? The two measures should be precisely the same, but data sources are not perfect. The difference between GDP and GDI is called the *statistical discrepancy*.)

It should be apparent that GDP is a sophisticated measure of the value of economic activity. In advanced courses in macroeconomics, you will learn more about the nuances of its calculation. But even now you can see that each phrase in this definition is packed with meaning.

FYI

Other Measures of Income

When the U.S. Department of Commerce computes the nation's GDP, it also computes various other measures of income to get a more complete picture of what's happening in the economy. These other measures differ from GDP by excluding or including certain categories of income. What follows is a brief description of five of these income measures, ordered from largest to smallest.

- *Gross national product* (GNP) is the total income earned by a nation's permanent residents (called *nationals*). It differs from GDP in that it includes income that our citizens earn abroad and excludes income that foreigners earn here. For example, when a Canadian citizen works temporarily in the United States, her production is part of U.S. GDP, but it is not part of U.S. GNP. (It is part of Canada's GNP.) For most countries, including the United States, domestic residents are responsible for most domestic production, so GDP and GNP are quite close.
- *Net national product* (NNP) is the total income of a nation's residents (GNP) minus losses from depreciation. *Depreciation* is the wear and tear on the economy's stock of equipment and structures, such as trucks rusting and old computer models becoming obsolete. In the national income accounts prepared by the Department of Commerce, depreciation is called the "consumption of fixed capital."
- *National income* is the total income earned by a nation's residents in the production of goods and services. It is almost identical to net national product. These two measures differ because of the *statistical discrepancy* that arises from problems in data collection.
- *Personal income* is the income that households and noncorporate businesses receive. Unlike national income, it excludes *retained earnings*, the income that corporations earn but do not pay out to their owners. It also subtracts indirect business taxes (such as sales taxes), corporate income taxes, and contributions for social insurance (mostly Social Security taxes). In addition, personal income includes the interest income that households receive from their holdings of government debt and the income that households receive from government transfer programs, such as welfare and Social Security.
- *Disposable personal income* is the income that households and noncorporate businesses have left after satisfying all their obligations to the government. It equals personal income minus personal taxes and certain nontax payments (such as traffic tickets).

Although the various measures of income differ in detail, they almost always tell the same story about economic conditions. When GDP grows rapidly, these other measures of income tend to grow rapidly. And when GDP falls, these other measures tend to fall as well. As a result, for monitoring fluctuations in the overall economy, it does not matter much which measure of income we use. ■

QuickQuiz

3. If the price of a hot dog is $2 and the price of a hamburger is $4, then 30 hot dogs contribute as much to GDP as _____ hamburgers.
   a. 5
   b. 15
   c. 30
   d. 60

4. Angus the sheep farmer sells wool to Barnaby the knitter for $20. Barnaby makes two sweaters, each of which has a market price of $40. Collette buys one of them, while the other remains on the shelf of Barnaby's store to be sold later. What is GDP here?
   a. $40
   b. $60
   c. $80
   d. $100

5. After graduation, an American college student moves to Japan to teach English. Her salary is included
   a. only in U.S. GDP.
   b. only in Japan's GDP.
   c. in both U.S. GDP and Japan's GDP.
   d. in neither U.S. GDP nor Japan's GDP.

Answers at end of chapter.

23-3 The Components of GDP

Spending in an economy takes many forms. At any moment, the Lopez family may be having lunch at Burger King; Ford may be building a car factory; the U.S. Navy may be procuring a submarine; and British Airways may be buying an airplane from Boeing. GDP includes all of these various forms of spending on domestically produced goods and services.

To understand how the economy is using its scarce resources, economists study the composition of GDP among various types of spending. To do this, GDP (which we denote as Y) is divided into four components: consumption (C), investment (I), government purchases (G), and net exports (NX):

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

This equation is an *identity*—an equation that must be true because of how the variables in the equation are defined. In this case, because each dollar of expenditure included in GDP is placed into one of the four components of GDP, the total of the four components must be equal to GDP. Let's look at each of these four components more closely.

23-3a Consumption

Consumption is spending by households on goods and services, with the exception of purchases of new housing. Goods include durable goods, such as automobiles and appliances, and nondurable goods, such as food and clothing. Services include such intangible items as haircuts and medical care. Household spending on education is also included in consumption of services (although one might argue that it would fit better in the next component).

consumption
spending by households on goods and services, with the exception of purchases of new housing

23-3b Investment

Investment is the purchase of goods (called *capital goods*) that will be used in the future to produce more goods and services. Investment is the sum of purchases of business capital, residential capital, and inventories. Business capital includes business structures (such as a factory or office building), equipment (such as a

investment
spending on business capital, residential capital, and inventories

worker's computer), and intellectual property products (such as the software that runs the computer). Residential capital includes the landlord's apartment building and a homeowner's personal residence. By convention, the purchase of a new house is the one type of household spending categorized as investment rather than consumption.

As mentioned earlier, the treatment of inventory accumulation is noteworthy. When Apple produces a computer and adds it to its inventory instead of selling it, Apple is assumed to have "purchased" the computer for itself. That is, the national income accountants treat the computer as part of Apple's investment spending. (When Apple later sells the computer out of inventory, the sale will subtract from Apple's inventory investment, offsetting the positive expenditure of the buyer.) Inventories are treated this way because GDP aims to measure the value of the economy's production, and goods added to inventory are part of that period's production.

Note that GDP accounting uses the word *investment* differently from how you might hear the term in everyday conversation. When you hear the word *investment*, you might think of financial investments, such as stocks, bonds, and mutual funds—topics that we study later in this book. By contrast, because GDP measures expenditure on goods and services, here the word *investment* means purchases of goods (such as business capital, residential structures, and inventories) that will be used to produce other goods and services in the future.

23-3c Government Purchases

government purchases
spending on goods and services by local, state, and federal governments

Government purchases measure spending on goods and services by local, state, and federal governments. This component includes the salaries of government workers as well as expenditures on public works. Recently, the U.S. national income accounts have switched to the longer label *government consumption expenditure and gross investment*, but here we will use the traditional and shorter term *government purchases*.

The meaning of government purchases requires some clarification. When the government pays the salary of an Army general or a schoolteacher, that salary is included in government purchases. But when the government pays a Social Security benefit to an elderly person or an unemployment insurance benefit to a recently laid off worker, the story is very different: These are called *transfer payments* because they are not made in exchange for a currently produced good or service. Transfer payments alter household income, but they do not reflect the economy's production. (From a macroeconomic standpoint, transfer payments are like negative taxes.) Because GDP is intended to measure income from, and expenditure on, the production of goods and services, transfer payments are not counted as government purchases.

23-3d Net Exports

net exports
spending on domestically produced goods by foreigners (exports) minus spending on foreign goods by domestic residents (imports)

Net exports equal the foreign purchases of domestically produced goods (exports) minus the domestic purchases of foreign goods (imports). A domestic firm's sale to a buyer in another country, such as Boeing's sale of an airplane to British Airways, increases net exports.

The *net* in *net exports* refers to the fact that imports are subtracted from exports. This subtraction is made because other components of GDP include imports of goods and services. For example, suppose that a household buys a $50,000 car from Volvo, the Swedish carmaker. This transaction increases consumption by $50,000 because car purchases are part of consumer spending. It also reduces net exports by $50,000 because the car is an import. In other words, net exports include goods

and services produced abroad (with a minus sign) because these goods and services are included in consumption, investment, and government purchases (with a plus sign). Thus, when a domestic household, firm, or government buys a good or service from abroad, the purchase does not affect GDP because it reduces net exports by the same amount that it raises consumption, investment, or government purchases.

CASE STUDY

THE COMPONENTS OF U.S. GDP

Table 1 shows the composition of U.S. GDP in 2018. In this year, the GDP of the United States was more than $20 trillion. Dividing this number by the 2018 U.S. population of 327 million yields GDP per person (sometimes called GDP per capita) and reveals that the income and expenditure of the average American in 2018 was $62,609.

Consumption made up 68 percent of GDP, or $42,609 per person. Investment was $11,154 per person. Government purchases were $10,758 per person. Net exports were –$1,911 per person. This number is negative because Americans spent more on foreign goods than foreigners spent on American goods.

These data come from the Bureau of Economic Analysis, the part of the U.S. Department of Commerce that produces the national income accounts. You can find more recent data on GDP on its website, http://www.bea.gov. ●

TABLE 1

GDP and Its Components

This table shows total GDP for the U.S. economy in 2018 and the breakdown of GDP among its four components. When reading this table, recall the identity $Y = C + I + G + NX$.

	Total (in billions of dollars)	Per Person (in dollars)	Percent of Total
Gross domestic product, *Y*	$20,501	$62,609	100%
Consumption, *C*	13,952	42,609	68
Investment, *I*	3,652	11,154	18
Government purchases, *G*	3,523	10,758	17
Net exports, *NX*	–626	–1,911	–3

Source: U.S. Department of Commerce. Parts may not sum to totals due to rounding.

QuickQuiz

6. Which of the following does NOT add to U.S. GDP?
   a. Boeing manufactures and sells a plane to Air France.
   b. General Motors builds a new auto factory in North Carolina.
   c. The city of New York pays a salary to a policeman.
   d. The federal government sends a Social Security check to your grandmother.
7. An American buys a pair of shoes made in Italy. How do the U.S. national income accounts treat the transaction?
   a. Net exports and GDP both rise.
   b. Net exports and GDP both fall.
   c. Net exports fall, while GDP does not change.
   d. Net exports do not change, while GDP rises.
8. Which is the largest component of GDP?
   a. consumption
   b. investment
   c. government purchases
   d. net exports

Answers at end of chapter.

23-4 Real versus Nominal GDP

As we have seen, GDP measures the total spending on goods and services in all markets in the economy. If total spending rises from one year to the next, at least one of two things must be true: (1) the economy is producing a larger output of goods and services, or (2) goods and services are being sold at higher prices. When studying changes in the economy over time, economists want to separate these two effects. In particular, they want a measure of the total quantity of goods and services the economy is producing independent of changes in the prices of those goods and services.

To do this, economists use a measure called *real GDP*. Real GDP answers a hypothetical question: What would be the value of the goods and services produced this year if valued using the prices that prevailed in some specific year in the past? By evaluating current production using prices that are fixed at past levels, real GDP shows how the economy's overall production of goods and services changes over time.

To see more precisely how real GDP is constructed, let's consider an example.

23-4a A Numerical Example

Table 2 shows some data for an economy that produces only two goods: hot dogs and hamburgers. The table shows the prices and quantities produced of the two goods in the years 2019, 2020, and 2021.

To compute total spending in this economy, we multiply the quantities of hot dogs and hamburgers by their prices. In the year 2019, 100 hot dogs are sold at a price of $1 per hot dog, so expenditure on hot dogs equals $100. In the same year, 50 hamburgers are sold for $2 per hamburger, so expenditure on hamburgers also

TABLE 2

Real and Nominal GDP

This table shows how to calculate real GDP, nominal GDP, and the GDP deflator for a hypothetical economy that produces only hot dogs and hamburgers.

Prices and Quantities

Year	Price of Hot Dogs	Quantity of Hot Dogs	Price of Hamburgers	Quantity of Hamburgers
2019	$1	100	$2	50
2020	2	150	3	100
2021	3	200	4	150

Calculating Nominal GDP

2019	($1 per hot dog × 100 hot dogs) + ($2 per hamburger × 50 hamburgers) = $200
2020	($2 per hot dog × 150 hot dogs) + ($3 per hamburger × 100 hamburgers) = $600
2021	($3 per hot dog × 200 hot dogs) + ($4 per hamburger × 150 hamburgers) = $1,200

Calculating Real GDP (base year 2019)

2019	($1 per hot dog × 100 hot dogs) + ($2 per hamburger × 50 hamburgers) = $200
2020	($1 per hot dog × 150 hot dogs) + ($2 per hamburger × 100 hamburgers) = $350
2021	($1 per hot dog × 200 hot dogs) + ($2 per hamburger × 150 hamburgers) = $500

Calculating the GDP Deflator

2019	($200/$200) × 100 = 100
2020	($600/$350) × 100 = 171
2021	($1,200/$500) × 100 = 240

equals $100. Total expenditure in the economy—the sum of expenditure on hot dogs and expenditure on hamburgers—is $200. This amount, the production of goods and services valued at current prices, is called **nominal GDP**.

nominal GDP
the production of goods and services valued at current prices

The table shows the calculation of nominal GDP for these three years. Total spending rises from $200 in 2019 to $600 in 2020 and then to $1,200 in 2021. Part of this rise is attributable to the increase in the quantities of hot dogs and hamburgers, and part is attributable to the increase in the prices of hot dogs and hamburgers.

To remove the effect of price changes and obtain a measure of the amount produced, we use **real GDP**, which is the production of goods and services valued at constant prices. We calculate real GDP by first designating one year as a *base year*. We then use the prices of hot dogs and hamburgers in the base year to compute the value of goods and services in all the years. In other words, the prices in the base year provide the basis for comparing quantities in different years.

real GDP
the production of goods and services valued at constant prices

Suppose that we choose 2019 to be the base year in our example. We can then use the prices of hot dogs and hamburgers in 2019 to compute the value of goods and services produced in 2019, 2020, and 2021. Table 2 shows these calculations. To compute real GDP for 2019, we multiply the prices of hot dogs and hamburgers in 2019 (the base year) by the quantities of hot dogs and hamburgers produced in 2019. (Thus, for the base year, real GDP always equals nominal GDP.) To compute real GDP for 2020, we multiply the prices of hot dogs and hamburgers in 2019 (the base year) by the quantities of hot dogs and hamburgers produced in 2020. Similarly, to compute real GDP for 2021, we multiply the prices in 2019 by the quantities in 2021. When we find that real GDP has risen from $200 in 2019 to $350 in 2020 and then to $500 in 2021, we know that the increase is attributable to an increase in the quantities produced because the prices are being held fixed at base-year levels.

To sum up: *Nominal GDP uses current prices to value the economy's production of goods and services. Real GDP uses constant base-year prices to value the economy's production of goods and services.* Because price changes do not affect real GDP, changes in real GDP reflect only changes in the quantities produced. Thus, real GDP measures the economy's production of goods and services.

Our goal in computing GDP is to gauge how well the overall economy is performing. Because real GDP measures the economy's production of goods and services, it reflects the economy's ability to satisfy people's needs and desires. Thus, real GDP is a better gauge of economic well-being than is nominal GDP. When economists talk about the economy's GDP, they usually mean real GDP rather than nominal GDP. And when they talk about growth in the economy, they measure that growth as the percentage change in real GDP from one period to another.

23-4b The GDP Deflator

As we have just seen, nominal GDP reflects both the quantities of goods and services the economy is producing and the prices of those goods and services. By contrast, by holding prices constant at base-year levels, real GDP reflects only the quantities produced. From these two statistics, we can compute a third, called the GDP deflator, which reflects only the prices of goods and services.

The **GDP deflator** is calculated as follows:

GDP deflator
a measure of the price level calculated as the ratio of nominal GDP to real GDP times 100

$$\text{GDP deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100.$$

Because nominal GDP and real GDP must be the same in the base year, the GDP deflator for the base year always equals 100. The GDP deflator for subsequent years measures the change in nominal GDP from the base year that cannot be attributable to a change in real GDP.

The GDP deflator measures the current level of prices relative to the level of prices in the base year. To see why this is true, consider a couple of simple examples. First, imagine that the quantities produced in the economy rise over time but prices remain the same. In this case, both nominal and real GDP rise at the same rate, so the GDP deflator is constant. Now suppose, instead, that prices rise over time but the quantities produced stay the same. In this second case, nominal GDP rises but real GDP remains the same, so the GDP deflator rises. Notice that, in both cases, the GDP deflator reflects what's happening to prices but not to quantities.

Let's now return to our numerical example in Table 2. The GDP deflator is computed at the bottom of the table. For the year 2019, nominal GDP is $200 and real GDP is $200, so the GDP deflator is 100. (The deflator is always 100 in the base year.) For the year 2020, nominal GDP is $600 and real GDP is $350, so the GDP deflator is 171.

Economists use the term *inflation* to describe a situation in which the economy's overall price level is rising. The *inflation rate* is the percentage change in some measure of the price level from one period to the next. Using the GDP deflator, the inflation rate between two consecutive years is computed as follows:

$$\text{Inflation rate in year 2} = \frac{\text{GDP deflator in year 2} - \text{GDP deflator in year 1}}{\text{GDP deflator in year 1}} \times 100.$$

Because the GDP deflator rose in year 2020 from 100 to 171, the inflation rate is $100 \times (171 - 100)/100$, or 71 percent. In 2021, the GDP deflator rose to 240 from 171 the previous year, so the inflation rate is $100 \times (240 - 171)/171$, or 40 percent.

The GDP deflator is one measure that economists use to monitor the average level of prices in the economy and thus the rate of inflation. The GDP deflator gets its name because it can be used to take inflation out of nominal GDP—that is, to "deflate" nominal GDP for the rise that is due to increases in prices. In the next chapter, we examine another measure of the economy's price level, called the *consumer price index*, and discuss the differences between the two measures.

A HALF CENTURY OF REAL GDP

Now that we know how real GDP is defined and measured, let's look at what this macroeconomic variable tells us about the recent history of the United States. Figure 2 shows quarterly data on real GDP for the U.S. economy since 1965.

The most obvious feature of these data is that real GDP grows over time. The real GDP of the U.S. economy in 2018 was more than four times its 1965 level. Put differently, the output of goods and services produced in the United States has grown on average about 3 percent per year. Because this continued growth in real GDP exceeds the rate of population growth, it enables most Americans to enjoy greater economic prosperity than their parents and grandparents did.

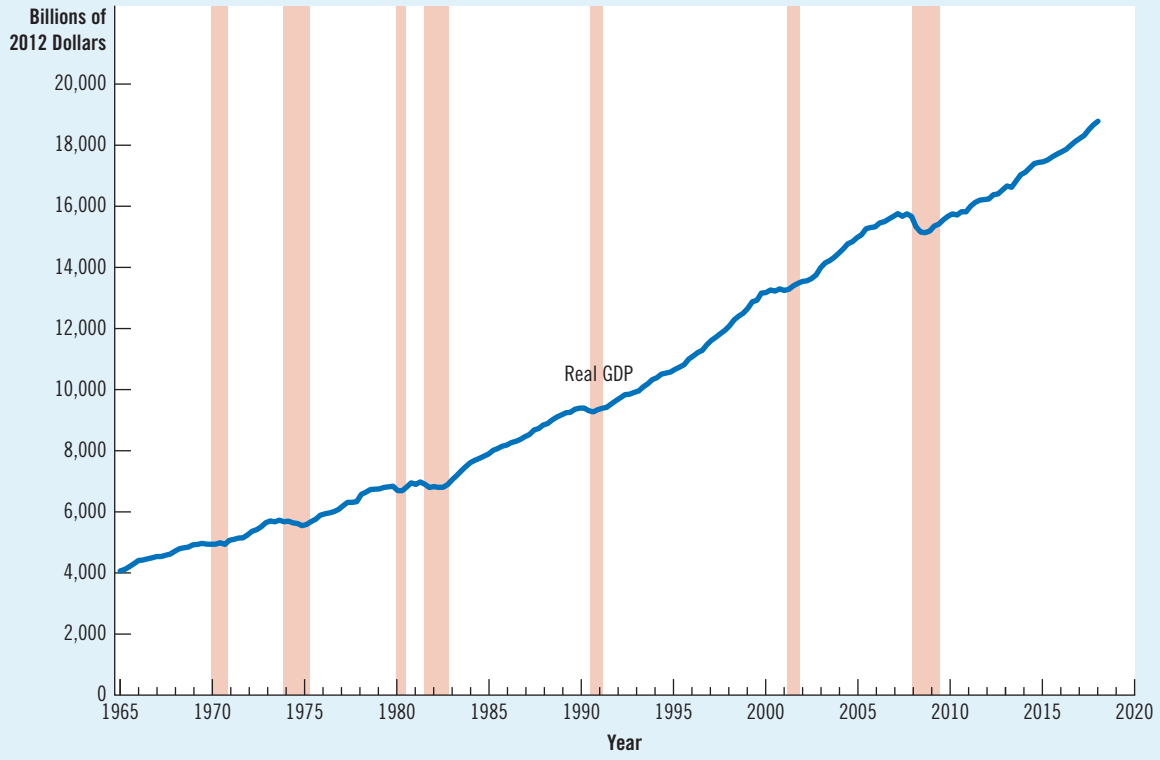
A second feature of the GDP data is that growth is not steady. The upward climb of real GDP is occasionally interrupted by periods during which GDP declines, called *recessions*. Figure 2 marks recessions with shaded vertical bars. (There is no ironclad rule for when the official business cycle dating committee will declare that a recession has occurred, but an old rule of thumb is two consecutive quarters of falling real GDP.) Recessions are associated not only with lower incomes but also with other forms of economic distress: rising unemployment, falling profits, increased bankruptcies, and so on.

This figure shows quarterly data on real GDP for the U.S. economy since 1965. Recessions—periods of falling real GDP—are marked with the shaded vertical bars.

Source: U.S. Department of Commerce.

FIGURE 2

Real GDP in the United States



Much of macroeconomics aims to explain the long-run growth and short-run fluctuations in real GDP. As we will see in the coming chapters, we need different models for these two purposes. Because the short-run fluctuations represent deviations from the long-run trend, we first examine the behavior of key macroeconomic variables, including real GDP, in the long run. Then in later chapters, we build on this analysis to explain short-run fluctuations. ●

QuickQuiz

9. An economy produces 10 cookies in year 1 at a price of $2 per cookie and 12 cookies in year 2 at a price of $3 per cookie. From year 1 to year 2, real GDP increases by
   a. 20 percent.
   b. 50 percent.
   c. 70 percent.
   d. 80 percent.

10. If all quantities produced rise by 5 percent and all prices fall by 5 percent, which of the following best describes what occurs?
   a. Real GDP rises by 5 percent, while nominal GDP falls by 5 percent.
   b. Real GDP rises by 5 percent, while nominal GDP is unchanged.
   c. Real GDP is unchanged, while nominal GDP rises by 5 percent.
   d. Real GDP is unchanged, while nominal GDP falls by 5 percent.

Answers at end of chapter.

23-5 Is GDP a Good Measure of Economic Well-Being?

Earlier in this chapter, GDP was called the single best measure of the economic well-being of a society. Now that we know what GDP is, we can evaluate this claim.

As we have seen, GDP measures both the economy's total income and the economy's total expenditure on goods and services. Thus, GDP per person tells us the income and expenditure of the average person in the economy. Because most people would prefer to receive higher income and enjoy higher expenditure, GDP per person seems a natural measure of the economic well-being of the average individual.

Yet some people dispute the validity of GDP as a measure of well-being. When Senator Robert Kennedy was running for president in 1968, he gave a moving critique of such economic measures:

> [Gross domestic product] does not allow for the health of our children, the quality of their education, or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our courage, nor our wisdom, nor our devotion to our country. It measures everything, in short, except that which makes life worthwhile, and it can tell us everything about America except why we are proud that we are Americans.

Much of what Robert Kennedy said is correct. Why, then, do we care about GDP?

The answer is that a larger GDP does in fact help us lead better lives. GDP does not measure the health of our children, but nations with larger GDP can afford better healthcare for their children. GDP does not measure the quality of their education, but nations with larger GDP can afford better educational systems. GDP does not measure the beauty of our poetry, but nations with larger GDP can afford to teach more of their citizens to read and enjoy poetry. GDP does not take account of our intelligence, integrity, courage, wisdom, or devotion to country, but all of these virtues are easier to foster when people are less concerned about affording the material necessities of life. In short, GDP does not directly measure those things that make life worthwhile, but it does measure our ability to obtain many of the inputs for a worthwhile life.

GDP is not, however, a perfect measure of well-being. It omits some things that contribute to a good life, such as leisure. Suppose, for instance, that everyone in the economy suddenly started working every day of the week, rather than taking weekends off. More goods and services would be produced, and GDP would rise. But despite the increase in GDP, we should not conclude that everyone would be better off. The loss from reduced leisure would offset the gain from producing and consuming a greater quantity of goods and services.

Because GDP uses market prices to value goods and services, it excludes the value of almost all activity that takes place outside markets. In particular, GDP omits the value of goods and services produced at home. When a chef prepares a delicious meal and sells it at her restaurant, the value of that meal is part of GDP. But if the chef prepares the same meal for her family, the value she has added to the raw ingredients is left out of GDP. Similarly, child care provided in day-care centers is part of GDP, whereas child care by parents at home is not. Volunteer work also contributes to the well-being of those in society, but GDP does not reflect these contributions.

Another thing that GDP excludes is the quality of the environment. Imagine that the government eliminated all environmental regulations. Firms could then produce goods and services without considering the pollution they create, and GDP might rise. Yet well-being would most likely fall. The deterioration in the quality of air and water would more than offset the gains from greater production.

GDP also says nothing about the distribution of income. Consider two societies, one in which 100 people have annual incomes of $50,000 and another in which

10 people earn $500,000 and 90 suffer with nothing at all. Both societies have GDP of $5 million and GDP per person of $50,000. Yet few people would consider the two situations equivalent. While GDP per person tells us what's happening to the average person, behind the average lies a large variety of personal experiences.

In the end, we can conclude that GDP is a good measure of economic well-being for most—but not all—purposes. It is important to keep in mind what GDP includes and what it leaves out.

CASE STUDY

INTERNATIONAL DIFFERENCES IN GDP AND THE QUALITY OF LIFE

One way to gauge the usefulness of GDP as a measure of economic well-being is to examine international data. Rich and poor countries have vastly different levels of GDP per person. If a large GDP leads to a higher standard of living, then we should observe GDP to be strongly correlated with various measures of the quality of life. And, in fact, we do.

Table 3 shows 12 large nations ranked in order of GDP per person. The table also shows life expectancy at birth, the average years of schooling among adults, and an index of life satisfaction based on asking people to gauge how they feel about their lives on a scale of 0 to 10 (with 10 being the best). These data show a clear pattern. In rich countries, such as the United States and Germany, people have life expectancy of about 80, acquire about 13 years of schooling, and rate their life satisfaction at about 7. In poor countries, such as Bangladesh and Nigeria, people typically die about 10 years earlier, have less than half as much schooling, and rate their life satisfaction about 2 points lower on the 10-point scale.

Data on other aspects of the quality of life tell a similar story. Countries with low GDP per person tend to have more infants with low birth weight, higher rates of infant mortality, higher rates of maternal mortality, and higher rates of child malnutrition. They also have lower rates of access to electricity, paved roads, and clean drinking water. In these countries, fewer school-age children are actually in school, those who are in school must learn with fewer teachers per student, and

TABLE 3

GDP and the Quality of Life

The table shows GDP per person and three other measures of the quality of life for 12 major countries.

Source: *Human Development Indices and Indicators: 2018 Statistical Update,* United Nations. Real GDP is for 2017, expressed in 2011 dollars. Average years of schooling is among adults 25 years and older.

Country	Real GDP per Person	Life Expectancy	Average Years of Schooling	Overall Life Satisfaction (0 to 10 scale)
United States	$54,941	80 years	13 years	7.0
Germany	46,136	81	14	7.1
Japan	38,986	84	13	5.9
Russia	24,233	71	12	5.6
Mexico	16,944	77	9	6.4
China	15,270	76	8	5.1
Brazil	13,755	76	8	6.3
Indonesia	10,846	69	8	5.1
India	6,353	69	6	4.0
Pakistan	5,311	67	5	5.8
Nigeria	5,231	54	6	5.3
Bangladesh	3,677	73	6	4.3

IN THE NEWS

Sex, Drugs, and GDP

Some nations are debating what to include in their national income accounts.

No Sex, Please, We're French

By Zachary Karabell

The government of France has just made what on the face of it appears to be a nonannouncement announcement: It will not include illegal drugs and prostitution in its official calculation of the country's gross domestic product.

What made the announcement odd was that it never has included such activities, nor have most countries. Nor do most governments announce what they do not plan to do. ("The U.S. government has no intention of sending a man to Venus.") Yet the French decision comes in the wake of significant pressure from neighboring countries and from the European Union to integrate these activities into national accounts and economic output. That raises a host of questions: *Should* these activities be included, and if those are, why not others? And what exactly are we measuring—and why?

Few numbers shape our world today more than GDP. It has become the alpha and omega of national success, used by politicians and pundits as the primary gauge of national strength and treated as a numerical proxy for greatness or the lack thereof.

Yet GDP is only a statistic, replete with the limitations of all statistics. Created as an outgrowth of national accounts that were themselves only devised in the 1930s, GDP was never an all-inclusive measure, even as it is treated as such. Multiple areas of economic life were left out, including volunteer work and domestic work.

Now Eurostat, the official statistical agency of the European Union, is leading the drive to include a host of illegal activities in national calculations of GDP, most notably prostitution and illicit drugs. The argument, as a United Nations commission laid out in 2008, is fairly simple: Prostitution and illicit drugs are significant economic activities, and if they're not factored into economic statistics, then we're looking at an incomplete picture—which in turn will make it that much harder to craft smart policy. Additionally, different countries have different laws: In the Netherlands, for instance, prostitution is legal, as is marijuana. Those commercial transactions (or at least those that are recorded and taxed) are already part of Dutch GDP. Not including them in Italy's or Spain's GDPs can thus make it challenging to compare national numbers.

That is why Spain, Italy, Belgium, and the U.K. have in recent months moved to include

illiteracy among adults is more common. The citizens of these nations tend to have fewer televisions, fewer telephones, and fewer opportunities to access the Internet. International data leave no doubt that a nation's GDP per person is closely associated with its population's standard of living. ●

QuickQuiz

11. If Mr. Keating quits his job as a teacher to home school his own children, GDP
    a. stays the same because he is engaged in the same activity.
    b. rises because he now pays lower income taxes.
    c. falls because his market income decreases.
    d. could rise or fall, depending on the value of home schooling.

12. GDP is an imperfect measure of well-being because it
    a. includes physical goods produced but not intangible services.
    b. excludes goods and services provided by the government.
    c. ignores the environmental degradation from economic activity.
    d. is not correlated with other measures of the quality of life.

Answers at end of chapter.

illegal drugs and nonlicensed sex trade in their national accounts. The U.K. Office for National Statistics in particular approached its mandate with wonkish seriousness, publishing a 20-page précis of its methodology that explained how it would, say, calculate the dollar amount of prostitution (police records help) or deal with domestically produced drugs versus imported drugs. The result, which will be formally announced in September, will be an additional 10 billion pounds added to Great Britain's GDP.

France, however, has demurred. A nation with a clichéd reputation for a certain savoir faire when it comes to sex and other nocturnal activities has decided (or at least its bureaucrats have) that in spite of an EU directive, it will not calculate the effects of illegal activities that are often nonconsensual or nonvoluntary. That is clearly the case for some prostitution—one French minister stated that "street prostitution" is largely controlled by the Mafia—and the same could be reasonably said of the use of some hard drugs, given their addictive nature.

There is undeniably a strong moralistic component in the French decision. By averring that because they are not voluntary or consensual these exchanges should not be included in GDP, the French government is placing a moral vision of what society *should be* ahead of an economic vision of what society *is*. That in turn makes an already messy statistic far messier, and that serves no one's national interests. . . .

With all of GDP's limitations, adding a new moral dimension would only make the number that much less useful. After all, why stop at not including prostitution because it degrades women? Why not refuse to measure coal production because it degrades the environment? Why not leave out cigarette usage because it causes cancer? The list of possible exclusions on this basis is endless.

If GDP is our current best metric for national output, then at the very least it should attempt to include all measurable output. The usually moralistic United States has actually been including legal prostitution in Nevada and now marijuana sales and consumption in Colorado, California, and Washington without any strong objections based solely on the argument that these are commercial exchanges that constitute this fuzzy entity we call "the economy." . . .

Not measuring drugs and sex won't make them go away, but it will hobble efforts to understand the messy latticework of our economic lives, all in a futile attempt to excise what we do not like. ■

Questions to Discuss

1. Do you think illegal activities should be included in GDP? Why or why not?
2. Are there legal activities that you view as socially undesirable? If so, which ones? Do you think that GDP should include these activities? Why or why not?

Source: *Slate*, June 20, 2014.

23-6 Conclusion

In this chapter we learned how economists measure the total income of a nation. Measurement is, of course, only a starting point. Much of macroeconomics is aimed at revealing the long-run and short-run determinants of a nation's gross domestic product. Why, for example, is GDP higher in the United States and Japan than in India and Nigeria? What can the governments of the poorest countries do to promote more rapid GDP growth? Why does GDP in the United States rise rapidly in some years and fall in others? What can U.S. policymakers do to reduce the severity of these fluctuations in GDP? These are the questions we will take up shortly.

At this point, it is important to acknowledge the significance of just measuring GDP. We all get some sense of how the economy is doing as we go about our lives. But to do their jobs well, economists and policymakers need more than this vague sense: They need concrete data on which to base their judgments. Quantifying the behavior of the economy with statistics such as GDP is, therefore, the first step to developing a science of macroeconomics.

CHAPTER IN A NUTSHELL

- Because every transaction has a buyer and a seller, the total expenditure in the economy must equal the total income in the economy.
- Gross domestic product (GDP) measures an economy's total expenditure on newly produced goods and services and the total income earned from the production of these goods and services. More precisely, GDP is the market value of all final goods and services produced within a country in a given period of time.
- GDP consists of four components of expenditure: consumption, investment, government purchases, and net exports. Consumption includes spending on goods and services by households, with the exception of purchases of new housing. Investment includes spending on business capital, residential capital, and inventories. Government purchases include spending on goods and services by local, state, and federal governments. Net exports equal the value of goods and services produced domestically and sold abroad (exports) minus the value of goods and services produced abroad and sold domestically (imports).
- Nominal GDP uses current prices to value the economy's production of goods and services. Real GDP uses constant base-year prices to value the economy's production of goods and services. The GDP deflator—calculated from the ratio of nominal GDP to real GDP—measures the level of prices in the economy.
- GDP is a good measure of economic well-being because people prefer higher to lower incomes. But it is not a perfect measure of well-being. For example, GDP excludes the value of leisure and the value of a clean environment.

KEY CONCEPTS

microeconomics, *p. 468*
macroeconomics, *p. 468*
gross domestic product (GDP), *p. 470*
consumption, *p. 473*
investment, *p. 473*
government purchases, *p. 474*
net exports, *p. 474*
nominal GDP, *p. 477*
real GDP, *p. 477*
GDP deflator, *p. 477*

QUESTIONS FOR REVIEW

1. Explain why an economy's income must equal its expenditure.
2. Which contributes more to GDP—the production of an economy car or the production of a luxury car? Why?
3. A farmer sells wheat to a baker for $2. The baker uses the wheat to make bread, which is sold for $3. What is the total contribution of these transactions to GDP?
4. Many years ago, Sophie paid $500 to put together a record collection. Today, she sold her albums at a garage sale for $100. How does this sale affect current GDP?
5. List the four components of GDP. Give an example of each.
6. Why do economists use real GDP rather than nominal GDP to gauge economic well-being?
7. In the year 2020, the economy produces 100 loaves of bread that sell for $2 each. In the year 2021, the economy produces 200 loaves of bread that sell for $3 each. Calculate nominal GDP, real GDP, and the GDP deflator for each year. (Use 2020 as the base year.) By what percentage does each of these three statistics rise from one year to the next?
8. Why is it desirable for a country to have a large GDP? Give an example of something that would raise GDP and yet be undesirable.

PROBLEMS AND APPLICATIONS

1. What components of GDP (if any) would each of the following transactions affect? Explain.
   a. Uncle Fester buys a new refrigerator from a domestic manufacturer.
   b. Aunt Dolly hires a local contractor to build her a new house.
   c. The Huang family buys an old Victorian house from the Ellis family.
   d. You pay a hairdresser for a haircut.
   e. Ford sells a Mustang from its inventory to the Martinez family.

f. Ford manufactures a Focus and sells it to Avis, the car rental company.
g. California hires workers to repave Highway 66.
h. The federal government sends your grandmother a Social Security check.
i. Your parents buy a bottle of French wine.
j. Honda expands its factory in Ohio.

2. Fill in the blanks:

Year	Real GDP (in 2000 dollars)	Nominal GDP (in current dollars)	GDP deflator (base year 2000)
1970	3,000	1,200	_____
1980	5,000	_____	60
1990	_____	6,000	100
2000	_____	8,000	_____
2010	_____	15,000	200
2020	10,000	_____	300
2030	20,000	50,000	_____

3. The government purchases component of GDP does not include spending on transfer payments such as Social Security. Thinking about the definition of GDP, explain why transfer payments are excluded.

4. As the chapter states, GDP does not include the value of used goods that are resold. Why would including such transactions make GDP a less informative measure of economic well-being?

5. Below are some data from the land of milk and honey.

Year	Price of Milk	Quantity of Milk	Price of Honey	Quantity of Honey
2020	$1	100 quarts	$2	50 quarts
2021	1	200	2	100
2022	2	200	4	100

a. Compute nominal GDP, real GDP, and the GDP deflator for each year, using 2020 as the base year.
b. Compute the percentage change in nominal GDP, real GDP, and the GDP deflator in 2021 and 2022 from the preceding year. For each year, identify the variable that does not change. Explain why your answer makes sense.
c. Did economic well-being increase more in 2021 or 2022? Explain.

6. Consider an economy that produces only chocolate bars. In year 1, the quantity produced is 3 bars and the price is $4 per bar. In year 2, the quantity produced is 4 bars and the price is $5 per bar. In year 3, the quantity produced is 5 bars and the price is $6 per bar. Year 1 is the base year.
a. What is nominal GDP for each of these three years?
b. What is real GDP for each of these years?
c. What is the GDP deflator for each of these years?
d. What is the percentage growth rate of real GDP from year 2 to year 3?
e. What is the inflation rate as measured by the GDP deflator from year 2 to year 3?
f. In this one-good economy, how might you have answered parts (d) and (e) without first answering parts (b) and (c)?

7. Consider the following data on the U.S. economy:

Year	Nominal GDP (in billions of dollars)	GDP Deflator (base year 2012)
2018	20,501	110.4
1998	9,063	75.3

a. What was the growth rate of nominal GDP between 1998 and 2018? (*Hint*: The growth rate of a variable X over an N-year period is calculated as $100 \times [(X_{\text{final}}/X_{\text{initial}})^{1/N} - 1]$.)
b. What was the growth rate of the GDP deflator between 1998 and 2018?
c. What was real GDP in 1998 measured in 2012 prices?
d. What was real GDP in 2018 measured in 2012 prices?
e. What was the growth rate of real GDP between 1998 and 2018?
f. Was the growth rate of nominal GDP higher or lower than the growth rate of real GDP? Explain.

8. Revised estimates of U.S. GDP are usually released by the government near the end of each month. Find a newspaper article that reports on the most recent release, or read the news release yourself at http://www.bea.gov, the website of the U.S. Bureau of Economic Analysis. Discuss the recent changes in real and nominal GDP and in the components of GDP.

9. A farmer grows wheat, which she sells to a miller for $100. The miller turns the wheat into flour, which she sells to a baker for $150. The baker turns the wheat into bread, which she sells to consumers for $180. Consumers eat the bread.
a. What is GDP in this economy? Explain.
b. *Value added* is defined as the value of a producer's output minus the value of the intermediate goods that the producer buys to make the output. Assuming there are no intermediate goods beyond those described above, calculate the value added of each of the three producers.
c. What is total value added of the three producers in this economy? How does it compare to the economy's GDP? Does this example suggest another way of calculating GDP?

10. Goods and services that are not sold in markets, such as food produced and consumed at home, are generally not included in GDP. How might this cause the numbers in the second column of Table 3 to be misleading in a comparison of the economic well-being of the United States and India? Explain.
11. The participation of women in the U.S. labor force has risen dramatically since 1970.
    a. How do you think this rise affected GDP?
    b. Now imagine a measure of well-being that includes time spent working in the home and taking leisure. How would the change in this measure of well-being compare to the change in GDP?
    c. Can you think of other aspects of well-being that are associated with the rise in women's labor-force participation? Would it be practical to construct a measure of well-being that includes these aspects?
12. One day, Barry the Barber, Inc., collects $400 for haircuts. Over this day, his equipment depreciates in value by $50. Of the remaining $350, Barry sends $30 to the government in sales taxes, takes home $220 in wages, and retains $100 in his business to add new equipment in the future. From the $220 that Barry takes home, he pays $70 in income taxes. Based on this information, compute Barry's contribution to the following measures of income.
    a. gross domestic product
    b. net national product
    c. national income
    d. personal income
    e. disposable personal income

QuickQuiz Answers

1. **c** 2. **d** 3. **b** 4. **c** 5. **b** 6. **d** 7. **c** 8. **a** 9. **a** 10. **b** 11. **c** 12. **c**

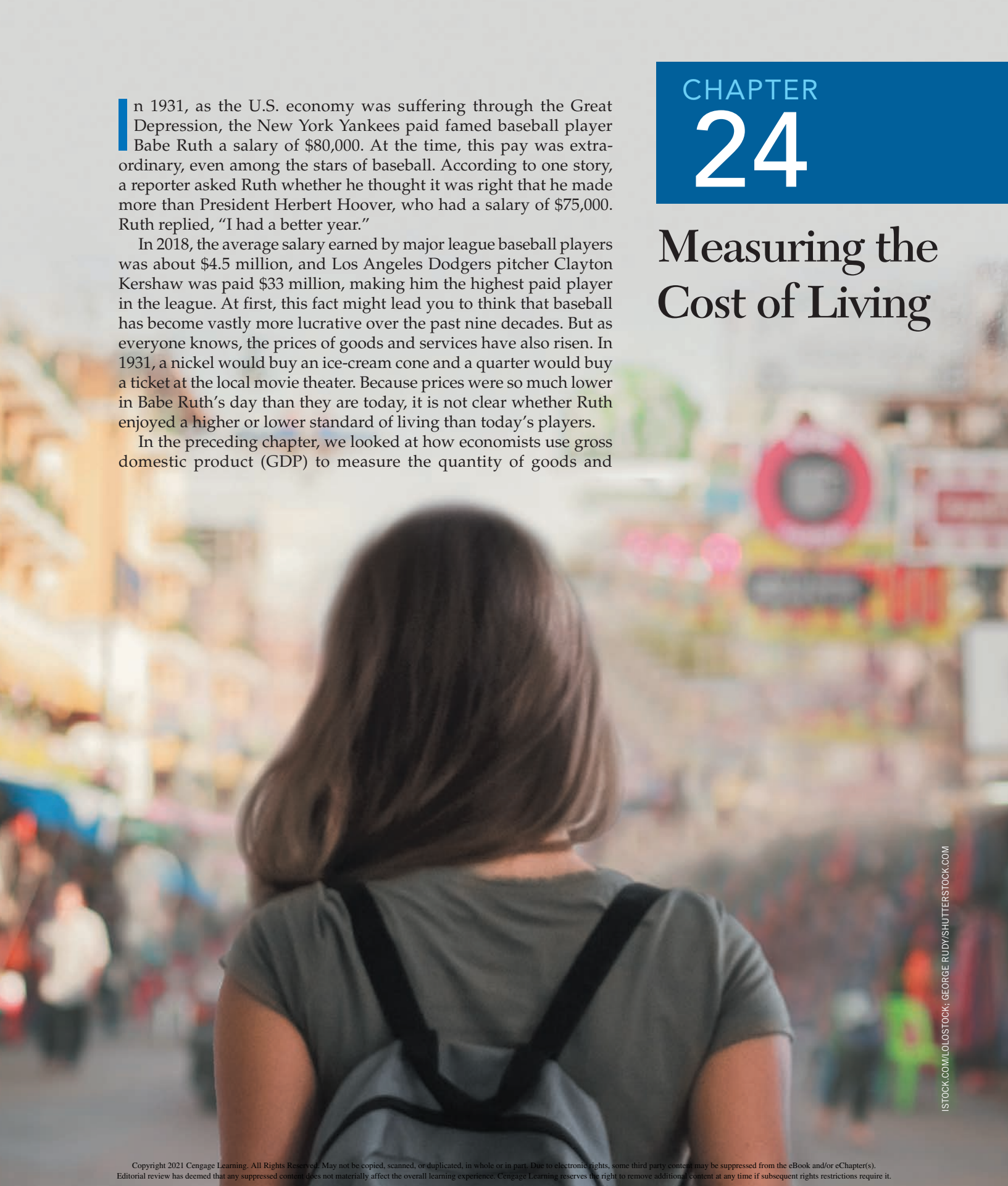
CHAPTER
24

Measuring the Cost of Living

In 1931, as the U.S. economy was suffering through the Great Depression, the New York Yankees paid famed baseball player Babe Ruth a salary of $80,000. At the time, this pay was extraordinary, even among the stars of baseball. According to one story, a reporter asked Ruth whether he thought it was right that he made more than President Herbert Hoover, who had a salary of $75,000. Ruth replied, "I had a better year."

In 2018, the average salary earned by major league baseball players was about $4.5 million, and Los Angeles Dodgers pitcher Clayton Kershaw was paid $33 million, making him the highest paid player in the league. At first, this fact might lead you to think that baseball has become vastly more lucrative over the past nine decades. But as everyone knows, the prices of goods and services have also risen. In 1931, a nickel would buy an ice-cream cone and a quarter would buy a ticket at the local movie theater. Because prices were so much lower in Babe Ruth's day than they are today, it is not clear whether Ruth enjoyed a higher or lower standard of living than today's players.

In the preceding chapter, we looked at how economists use gross domestic product (GDP) to measure the quantity of goods and



ISTOCK.COM/LOLOSTOCK; GEORGE RUDY/SHUTTERSTOCK.COM

services that the economy is producing. This chapter examines how economists measure the overall cost of living. To compare Babe Ruth's salary of $80,000 with today's salaries, we need to turn dollar figures into meaningful measures of purchasing power. That is exactly the job of a statistic called the *consumer price index*, or simply the CPI. After seeing how the CPI is constructed, we discuss how we can use such a price index to compare dollar figures from different points in time.

The CPI is used to monitor changes in the cost of living over time. When the CPI rises, the typical family has to spend more money to maintain the same standard of living. Economists use the term *inflation* to describe a situation in which the economy's overall price level is rising. The *inflation rate* is the percentage change in the price level from the previous period. The preceding chapter showed how economists can measure inflation using the GDP deflator. The inflation rate you are likely to hear on the nightly news, however, is calculated from the CPI, which better reflects the goods and services bought by consumers.

As we will see in the coming chapters, inflation is a closely watched aspect of macroeconomic performance and is a key variable guiding macroeconomic policy. This chapter provides the background for that analysis by showing how economists measure the inflation rate using the CPI and how this statistic can be used to compare dollar figures from different times.

24-1 The Consumer Price Index

consumer price index (CPI) a measure of the overall cost of the goods and services bought by a typical consumer

The **consumer price index (CPI)** is a measure of the overall cost of the goods and services bought by a typical consumer. Every month, the Bureau of Labor Statistics (BLS), which is part of the Department of Labor, computes and reports the CPI. In this section, we discuss how the CPI is calculated and what problems arise in its measurement. We also consider how this index compares with the GDP deflator, another measure of the overall level of prices, which we examined in the preceding chapter.

24-1a How the CPI Is Calculated

When the BLS calculates the CPI and the inflation rate, it uses data on the prices of thousands of goods and services. To see exactly how these statistics are constructed, let's consider a simple economy in which consumers buy only two goods: hot dogs and hamburgers. Table 1 shows the five steps that the BLS follows.

1. *Fix the basket.* Determine which prices are most important to the typical consumer. If the typical consumer buys more hot dogs than hamburgers, then the price of hot dogs is more important than the price of hamburgers and, therefore, should be given greater weight in measuring the cost of living. The BLS sets these weights by surveying consumers to find the basket of goods and services bought by the typical consumer. In the example in the table, the typical consumer buys a basket of 4 hot dogs and 2 hamburgers.
2. *Find the prices.* Find the prices of each of the goods and services in the basket at each point in time. The table shows the prices of hot dogs and hamburgers for three different years.
3. *Compute the basket's cost.* Use the data on prices to calculate the cost of the basket of goods and services at different times. The table shows this calculation for each of the three years. Notice that only the prices in this calculation change. By keeping the basket of goods the same (4 hot dogs and 2 hamburgers), we isolate the effects of price changes from the effects of any quantity changes that might be occurring at the same time.

TABLE 1

Calculating the Consumer Price Index and the Inflation Rate: An Example

This table shows how to calculate the CPI and the inflation rate for a hypothetical economy in which consumers buy only hot dogs and hamburgers.

Step 1: Survey Consumers to Determine a Fixed Basket of Goods

Basket = 4 hot dogs, 2 hamburgers

Step 2: Find the Price of Each Good in Each Year

Year	Price of Hot Dogs	Price of Hamburgers
2019	$1	$2
2020	2	3
2021	3	4

Step 3: Compute the Cost of the Basket of Goods in Each Year

2019	($1 per hot dog × 4 hot dogs) + ($2 per hamburger × 2 hamburgers) = $8 per basket
2020	($2 per hot dog × 4 hot dogs) + ($3 per hamburger × 2 hamburgers) = $14 per basket
2021	($3 per hot dog × 4 hot dogs) + ($4 per hamburger × 2 hamburgers) = $20 per basket

Step 4: Choose One Year as a Base Year (2019) and Compute the CPI in Each Year

2019	($8/$8) × 100 = 100
2020	($14/$8) × 100 = 175
2021	($20/$8) × 100 = 250

Step 5: Use the CPI to Compute the Inflation Rate from Previous Year

2020	(175 − 100)/100 × 100 = 75%
2021	(250 − 175)/175 × 100 = 43%

4. *Choose a base year and compute the index.* Designate one year as the base year, the benchmark against which other years are to be compared. (The choice of base year is arbitrary. The index is used to measure percentage changes in the cost of living, and these changes are the same regardless of the choice of base year.) Once the base year is chosen, the index is calculated as follows:

$$\text{Consumer price index} = \frac{\text{Price of basket of goods and services in current year}}{\text{Price of basket in base year}} \times 100.$$

That is, the CPI in any given year is the price of the basket of goods and services in that year divided by the price of the basket in the base year, multiplied by 100.

In the example in Table 1, 2019 is the base year. In this year, the basket of hot dogs and hamburgers costs $8. Therefore, to calculate the CPI, the price of the basket in each year is divided by $8 and multiplied by 100. The CPI is 100 in 2019. (The index is always 100 in the base year.) The CPI is 175 in 2020. This means that the price of the basket in 2020 is 175 percent of its price in the base year. Put differently, a basket of goods that costs $100 in the base year costs $175 in 2020. Similarly, the CPI is 250 in 2021, indicating that the price level in 2021 is 250 percent of the price level in the base year.

inflation rate
the percentage change in the price index from the preceding period

5. *Compute the inflation rate.* Use the CPI to calculate the **inflation rate**, which is the percentage change in the price index from the preceding period. That is, the inflation rate between two consecutive years is computed as follows:

$$\text{Inflation rate in year 2} = \frac{\text{CPI in year 2} - \text{CPI in year 1}}{\text{CPI in year 1}} \times 100.$$

As shown at the bottom of Table 1, the inflation rate in our example is 75 percent in 2020 and 43 percent in 2021.

Although this example simplifies the real world by considering a basket of only two goods, it shows how the BLS computes the CPI and the inflation rate. The BLS collects and processes data on the prices of thousands of goods and services every month and, by following the five foregoing steps, determines how quickly the cost of living for the typical consumer is rising. When the BLS makes its monthly announcement of the CPI, you can usually hear the number on the evening news or see it in your newsfeed.

core CPI
a measure of the overall cost of consumer goods and services excluding food and energy

In addition to the CPI for the overall economy, the BLS calculates several other price indexes. It reports the index for some narrow categories of goods and services, such as food, clothing, and energy. It also calculates the CPI for all goods and services excluding food and energy, a statistic called the **core CPI**. Because

FYI What's in the CPI's Basket?

When constructing the consumer price index, the Bureau of Labor Statistics tries to include all the goods and services that the typical consumer buys. Moreover, it tries to weight these goods and services according to how much consumers buy of each item.

Figure 1 shows the breakdown of consumer spending into the major categories of goods and services. By far the largest category is housing, which makes up 42 percent of the typical consumer's budget. This category includes the cost of shelter (33 percent), fuel and utilities (5 percent), and household furnishings and operation (4 percent). The next largest category, at 17 percent, is transportation, which includes spending on cars, gasoline, buses, subways, and so on. The next largest category, at 14 percent, is food and beverages; this category includes food at home (7 percent), food away from home (6 percent), and alcoholic beverages (1 percent). Next are medical care at 9 percent, education and communication at 7 percent, and recreation at 6 percent. Apparel, which includes clothing, footwear, and jewelry, makes up 3 percent of the typical consumer's budget.

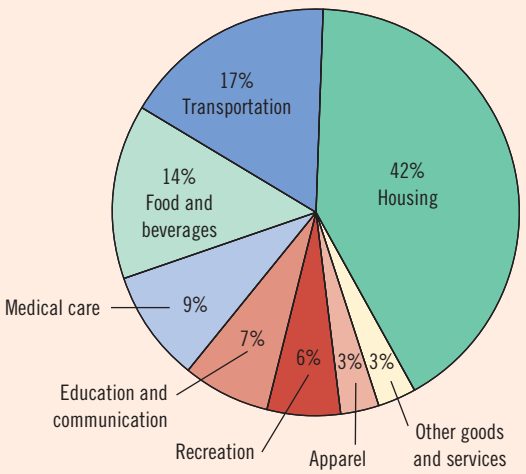
Also included in the figure, at 3 percent of spending, is a category for other goods and services. This category is a catchall for consumer purchases (such as cigarettes, haircuts, and funeral expenses) that do not naturally fit into the other categories. ■

FIGURE 1

The Typical Basket of Goods and Services

This figure shows how the typical consumer divides spending among various categories of goods and services. The Bureau of Labor Statistics calls each percentage the "relative importance" of the category.

Source: Bureau of Labor Statistics. Parts do not sum to 100 because of rounding.



food and energy prices show substantial short-run volatility, the core CPI better reflects underlying inflation trends. Finally, the BLS also calculates the **producer price index (PPI)**, which measures the cost of a basket of goods and services bought by firms rather than consumers. Because firms eventually pass on their costs to consumers in the form of higher consumer prices, changes in the PPI are often thought to be useful for predicting changes in the CPI.

producer price index (PPI) a measure of the cost of a basket of goods and services bought by firms

24-1b Problems in Measuring the Cost of Living

The goal of the consumer price index is to measure changes in the cost of living. In other words, the CPI tries to gauge how much incomes must rise to maintain a constant standard of living. The CPI, however, is not a perfect measure of the cost of living. Three problems with the index are widely acknowledged but difficult to solve.

The first problem is called *substitution bias*. When prices change from one year to the next, they do not all change proportionately: Some prices rise more than others. Consumers respond to these differing price changes by buying less of the goods whose prices have risen by relatively large amounts and by buying more of the goods whose prices have risen less or perhaps even have fallen. That is, consumers substitute toward goods that have become relatively less expensive. If a price index is computed assuming a fixed basket of goods, it ignores the possibility of consumer substitution and, therefore, overstates the increase in the cost of living from one year to the next.

Let's consider a simple example. Imagine that in the base year, apples are cheaper than pears, so consumers buy more apples than pears. When the BLS constructs the basket of goods, it will include more apples than pears. Suppose that next year pears are cheaper than apples. Consumers will naturally respond to the price changes by buying more pears and fewer apples. Yet when computing the CPI, the BLS uses a fixed basket, which in essence assumes that consumers continue buying the now expensive apples in the same quantities as before. For this reason, the index will measure a much larger increase in the cost of living than consumers actually experience.

A second problem with the CPI arises from the *introduction of new goods*. When a new good is introduced, consumers have more variety from which to choose, and this increased variety in turn reduces the cost of maintaining the same level of economic well-being. To see why, consider a hypothetical situation: Suppose you could choose between a $100 gift certificate at a large store that offered a wide array of goods and a $100 gift certificate at a small store with the same prices but a more limited selection. Which would you prefer? Most people would pick the store with greater variety. In essence, the increased set of possible choices makes each dollar more valuable. The same is true with the evolution of the economy over time: As new goods are introduced, consumers have more choices, and each dollar is worth more. But because the CPI is based on a fixed basket of goods and services, it does not reflect the increase in the value of the dollar that results from the introduction of new goods.

Again, let's consider an example. In 2001, Apple introduced the iPod, a small music-playing device that was a precursor to the iPhone. Devices to play music were available previously, but they were not nearly as portable and versatile. The iPod was a new option that increased consumers' opportunities. For any given number of dollars, the introduction of the iPod made people better off; conversely, achieving the same level of well-being required fewer dollars. A perfect cost-of-living index

would have reflected the decrease in the cost of living from the iPod's introduction. But because the CPI uses a fixed basket, it did not decrease when this new good was introduced. Eventually, the BLS revised the basket of goods to include the iPod, and subsequently, the index reflected changes in iPod prices. But the reduction in the cost of living associated with the initial introduction of the iPod never showed up in the index.

The third problem with the CPI is *unmeasured quality change*. If the quality of a good deteriorates from one year to the next while its price remains the same, you are getting a lesser good for the same amount of money, so the value of a dollar falls. Similarly, if the quality rises from one year to the next, the value of a dollar rises. The BLS does its best to account for quality change. When the quality of a good in the basket changes—for example, when a car model has more horsepower or gets better gas mileage from one year to the next—the Bureau adjusts the price of the good to account for the quality change. In doing so, it is trying to compute the price of a basket of goods of constant quality. Despite these efforts, changes in quality remain a problem because quality is hard to measure.

There is much debate among economists about how severe these measurement problems are and what should be done about them. Studies put the upward bias in measured inflation at about 0.5 to 1.0 percent per year. The issue is important because many government programs use the CPI to adjust for changes in the overall level of prices. Recipients of Social Security, for instance, get annual increases in benefits that are tied to the CPI. Some economists have suggested modifying these programs to correct for the measurement problems by, for instance, reducing the magnitude of the automatic benefit increases.

24-1c The GDP Deflator versus the Consumer Price Index

In the preceding chapter, we examined another measure of the overall level of prices in the economy—the GDP deflator. The GDP deflator is the ratio of nominal GDP to real GDP. Because nominal GDP is current output valued at current prices and real GDP is current output valued at base-year prices, the GDP deflator reflects the current level of prices relative to the level of prices in the base year.

Economists and policymakers monitor both the GDP deflator and the CPI to gauge how quickly prices are rising. Usually, these two statistics tell a similar story. Yet two important differences can cause them to diverge.

The first difference is that the GDP deflator reflects the prices of all goods and services *produced domestically*, whereas the CPI reflects the prices of all goods and services *bought by consumers*. For example, suppose that the price of an airplane produced by Boeing and sold to the Air Force rises. Even though the plane is part of GDP, it is not part of the basket of goods and services bought by a typical consumer. Thus, the price increase shows up in the GDP deflator but not in the CPI.

As another example, suppose that Volvo raises the price of its cars. Because Volvos are made in Sweden, the car is not part of U.S. GDP. But U.S. consumers buy Volvos, so the car is part of the typical consumer's basket of goods. Hence, a price increase in an imported consumption good, such as a Volvo, shows up in the CPI but not in the GDP deflator.

This first difference between the CPI and the GDP deflator is particularly important when the price of oil changes. The United States produces some oil, but much of the oil we use is imported. As a result, oil and oil products such as gasoline and

FROM THE WALL STREET JOURNAL—PERMISSION, CARTOON FEATURES SYNDICATE.

"The price may seem a little high, but you have to remember that's in today's dollars."

heating oil make up a much larger share of consumer spending than of GDP. When the price of oil rises, the CPI rises by much more than does the GDP deflator.

The second and subtler difference between the GDP deflator and the CPI concerns how various prices are weighted to yield a single number for the overall level of prices. The CPI compares the price of a *fixed* basket of goods and services with the price of the basket in the base year. Only occasionally does the BLS change the basket of goods. By contrast, the GDP deflator compares the price of *currently produced* goods and services with the price of those goods and services in the base year. Thus, the group of goods and services used to compute the GDP deflator changes automatically over time. This difference is not important when all prices are changing proportionately. But if the prices of different goods and services are changing by varying amounts, the way we weight the various prices affects the calculation of the overall inflation rate.

Figure 2 shows the inflation rate as measured by both the GDP deflator and the CPI for each year since 1965. You can see that sometimes the two measures diverge. When they do, it is possible to go behind these numbers and explain the divergence with the two differences we have discussed. For example, in 1979 and 1980, CPI inflation spiked up by more than inflation as measured by the GDP deflator largely because oil prices more than doubled during these two years. Conversely, in 2009 and 2015, CPI inflation fell well below inflation as gauged by the GDP deflator because of plummeting oil prices. Yet divergence between these two measures is the exception rather than the rule. Both the GDP deflator and the CPI show high rates of inflation in the 1970s and low rates of inflation since the mid-1980s.

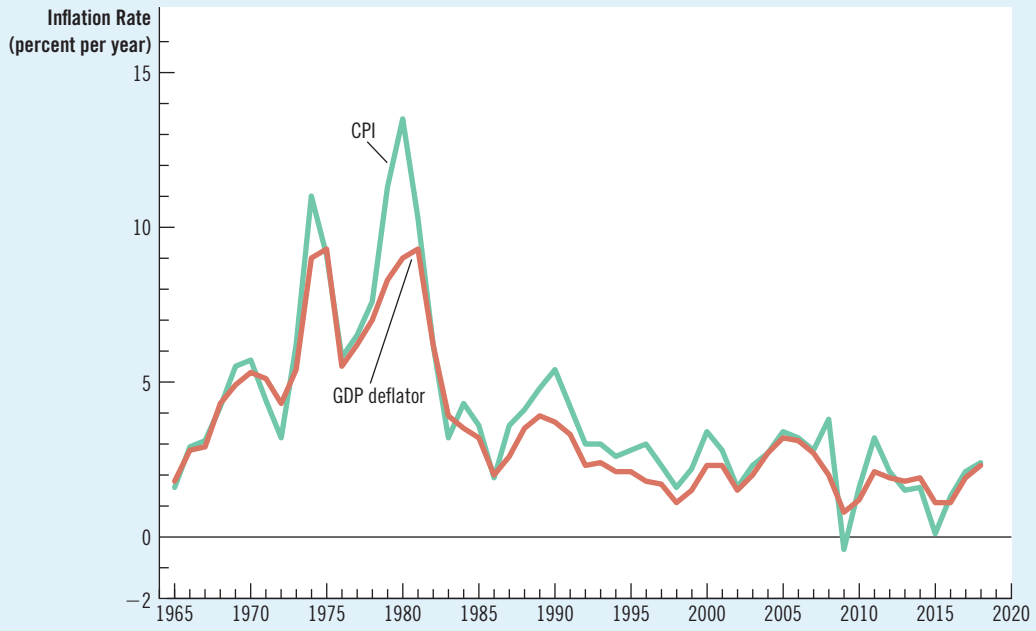


FIGURE 2

Two Measures of Inflation

This figure shows the inflation rate—the percentage change in the level of prices—as measured by the GDP deflator and the CPI using annual data since 1965. Notice that the two measures of inflation generally move together.

Source: U.S. Department of Labor; U.S. Department of Commerce.

QuickQuiz

1. The CPI measures approximately the same economic phenomenon as
   a. nominal GDP.
   b. real GDP.
   c. the GDP deflator.
   d. the unemployment rate.
2. The largest component in the basket of goods and services used to compute the CPI is
   a. food and beverages.
   b. housing.
   c. medical care.
   d. apparel.
3. If a Pennsylvania gun manufacturer raises the price of rifles it sells to the U.S. Army, its price hikes will increase
   a. both the CPI and the GDP deflator.
   b. neither the CPI nor the GDP deflator.
   c. the CPI but not the GDP deflator.
   d. the GDP deflator but not the CPI.
4. Because consumers can sometimes substitute cheaper goods for those that have risen in price,
   a. the CPI overstates inflation.
   b. the CPI understates inflation.
   c. the GDP deflator overstates inflation.
   d. the GDP deflator understates inflation.

Answers at end of chapter.

24-2 Correcting Economic Variables for the Effects of Inflation

The purpose of measuring the overall level of prices in the economy is to allow us to compare dollar figures from different times. Now that we know how price indexes are calculated, let's see how we might use such an index to compare a dollar figure from the past with a dollar figure in the present.

24-2a Dollar Figures from Different Times

We first return to the issue of Babe Ruth's salary. Was his salary of $80,000 in 1931 high or low compared to the salaries of today's players?

To answer this question, we need to know the level of prices in 1931 and the level of prices today. Part of the increase in baseball salaries compensates players for higher prices today. To compare Ruth's salary with the salaries of today's players, we need to inflate Ruth's salary to turn 1931 dollars into today's dollars.

The formula for turning dollar figures from year T into today's dollars is the following:

$$\text{Amount in today's dollars} = \text{Amount in year } T \text{ dollars} \times \frac{\text{Price level today}}{\text{Price level in year } T}.$$

A price index such as the CPI measures the price level and thus determines the size of the inflation correction.

Let's apply this formula to Ruth's salary. Government statistics show a CPI of 15.2 for 1931 and 251 for 2018. Thus, the overall level of prices has risen by a factor of 16.5 (calculated from 251/15.2). We can use these numbers to measure Ruth's salary in 2018 dollars, as follows:

$$\begin{aligned}\text{Salary in 2018 dollars} &= \text{Salary in 1931 dollars} \times \frac{\text{Price level in 2018}}{\text{Price level in 1931}} \\ &= \$80,000 \times \frac{251}{15.2} \\ &= \$1,321,053.\end{aligned}$$

We find that Babe Ruth's 1931 salary is equivalent to a salary today of over $1.3 million. That is a high income, but it is less than a third of the average player's salary today and only 4 percent of what star pitcher Clayton Kershaw earns. Various forces, including overall economic growth and the increasing income shares earned by superstars, have substantially raised the living standards of the best athletes.

Let's also examine President Hoover's 1931 salary of $75,000. To translate that figure into 2018 dollars, we again multiply it by the ratio of the price levels in the two years. We find that Hoover's salary is equivalent to $75,000 × (251/15.2), or $1,238,487 in 2018 dollars. This is well above President Donald Trump's salary of $400,000. It seems that President Hoover did have a pretty good year after all.

FYI

Mr. Index Goes to Hollywood

What is the most popular movie of all time? The answer might surprise you.

Movie popularity is often gauged by box office receipts. By that measure, *Star Wars: The Force Awakens* is the number-one movie of all time with domestic receipts of $937 million, followed by *Avatar* ($761 million) and *Black Panther* ($700 million). But this ranking ignores an obvious but important fact: Prices, including those of movie tickets, have been rising over time. Inflation gives an advantage to newer films.

LUCASFILM/PHOTO 12/ALAMY STOCK PHOTO

"May the force of inflation be with you."

When we correct box office receipts for the effects of inflation, the story is very different. The number-one movie is now *Gone with the Wind* ($1,784 million), followed by the original *Star Wars* ($1,573 million) and *The Sound of Music* ($1,258 million). *Star Wars: The Force Awakens* falls to number 11.

Gone with the Wind was released in 1939, before everyone had televisions in their homes. In the 1930s, about 90 million Americans went to the cinema each week, compared with about 25 million today. But the movies from that era don't show up in conventional popularity rankings because ticket prices were only a quarter. And indeed, in the ranking based on nominal box office receipts, *Gone with the Wind* does not make the top 100 films. Scarlett and Rhett fare a lot better once we correct for the effects of inflation. ■

CASE STUDY

REGIONAL DIFFERENCES IN THE COST OF LIVING

When you graduate from college, you may well have several job offers from which to choose. Not surprisingly, some jobs pay more than others. If the jobs are located in different places, however, be careful when comparing them. The cost of living varies not only over time but also across locations. What seems like a larger paycheck might not turn out to be so once you take into account regional differences in the prices of goods and services.

The Bureau of Economic Analysis has used the data collected for the CPI to compare prices around the United States. The resulting statistic is called

regional price parities. Just as the CPI measures variation in the cost of living from year to year, regional price parities measure variation in the cost of living from state to state.

Figure 3 shows the regional price parities for 2016. For example, living in the state of New York costs 115.6 percent of what it costs to live in the typical place in the United States (that is, New York is 15.6 percent more expensive than average). Living in Mississippi costs 86.4 percent of what it costs to live in the typical place (that is, Mississippi is 13.6 percent less expensive than average).

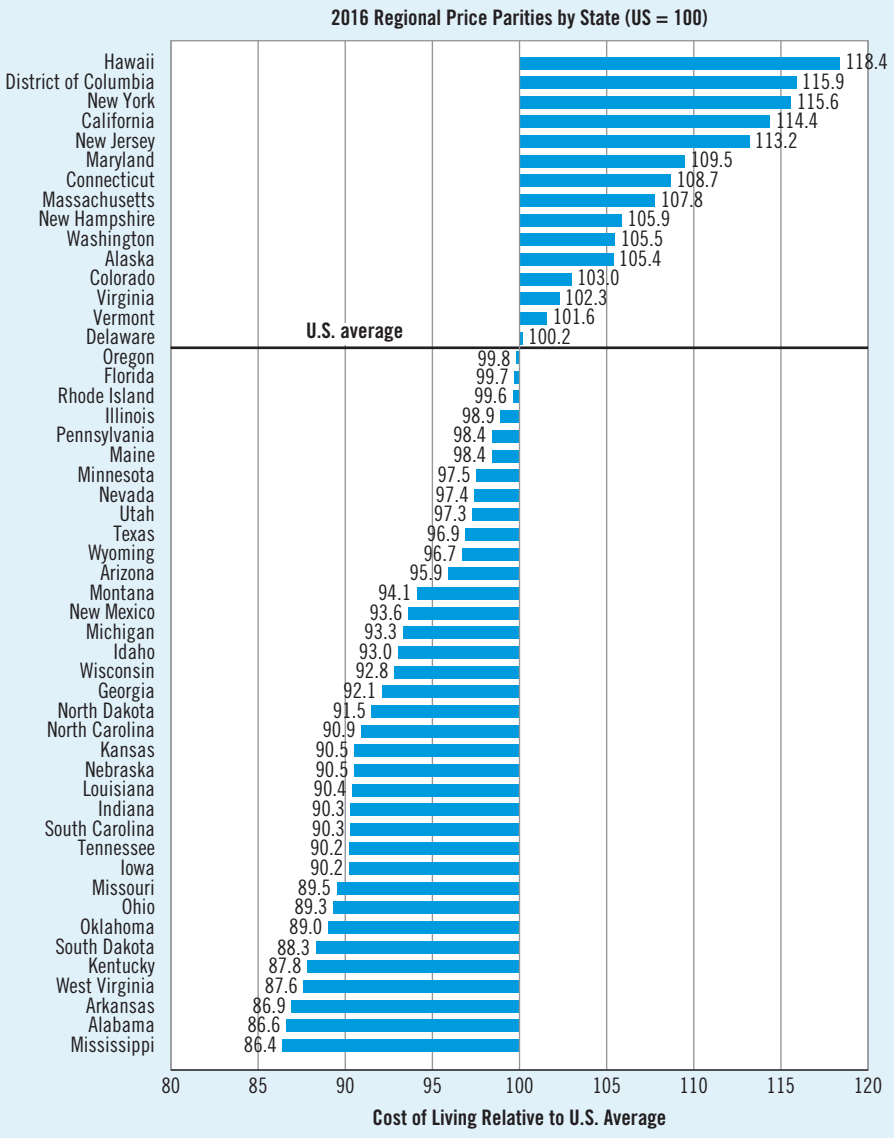
What accounts for these differences? It turns out that the prices of goods, such as food and clothing, explain only a small part of these regional differences. Most goods are tradable: They can be easily transported from one state to another. Because of regional trade, large price disparities are unlikely to persist for long.

FIGURE 3

Regional Variation in the Cost of Living

This figure shows how the costs of living in the 50 U.S. states and the District of Columbia compare to the U.S. average.

Source: U.S. Department of Commerce.



Services explain a larger part of these regional differences. A haircut, for example, can cost more in one state than in another. If barbers were willing to move to places where the price of a haircut is high, or if customers were willing to fly across the country in search of cheap haircuts, then the prices of haircuts across regions might well converge. But because transporting haircuts is so costly, large price disparities can persist.

Housing services are particularly important for understanding regional differences in the cost of living. Such services represent a large share of a typical consumer's budget. Moreover, once built, a house or apartment building can't easily be moved, and the land on which it sits is completely immobile. As a result, differences in housing costs can be persistently large. For example, rents in New York are almost twice those in Mississippi.

Keep these facts in mind when it comes time to compare job offers. Look not only at the dollar salaries but also at the local prices of goods and services, especially housing. ●

24-2b Indexation

As we have just seen, price indexes are used to correct for the effects of inflation when comparing dollar figures from different times. This type of correction shows up in many places in the economy. When some dollar amount is automatically corrected for changes in the price level by law or contract, the amount is said to be **indexed** for inflation.

indexation
the automatic correction by law or contract of a dollar amount for the effects of inflation

For example, some long-term contracts between firms and unions include partial or complete indexation of the wage to the CPI. Such a provision, called a *cost-of-living allowance* (or COLA), automatically raises the wage when the CPI rises.

Indexation is also a feature of many laws. Social Security benefits, for instance, are adjusted every year to compensate the elderly for increases in prices. The brackets of the federal income tax—the income levels at which the tax rates change—are also indexed for inflation. There are, however, many ways in which the tax system is not indexed for inflation, even when perhaps it should be. We discuss these issues more fully when we discuss the costs of inflation later in this book.

24-2c Real and Nominal Interest Rates

Correcting economic variables for the effects of inflation is particularly important, and somewhat tricky, when we look at data on interest rates. The very concept of an interest rate necessarily involves comparing amounts of money at different points in time. When you deposit your savings in a bank account, you give the bank some money now, and the bank returns your deposit with interest in the future. Similarly, when you borrow from a bank, you get some money now, but you will have to repay the loan with interest in the future. In both cases, to fully understand the deal between you and the bank, it is crucial to acknowledge that future dollars could have a different value than today's dollars. In other words, you have to correct for the effects of inflation.

Let's consider an example. Suppose Sara Saver deposits $1,000 in a bank account that pays an annual interest rate of 10 percent. A year later, after Sara has accumulated $100 in interest, she withdraws her $1,100. Is Sara $100 richer than she was when she made the deposit a year earlier?

The answer depends on what we mean by "richer." Sara does have $100 more than she had before. In other words, the number of dollars in her possession has risen by 10 percent. But Sara does not care about the amount of money itself: She

cares about what she can buy with it. If prices have risen while her money was in the bank, each dollar now buys less than it did a year ago. In this case, her purchasing power—the amount of goods and services she can buy—has not risen by 10 percent.

To keep things simple, let's suppose that Sara is a film buff and spends all her money on movie tickets. When Sara made her deposit, a ticket cost $10. Her deposit of $1,000 was equivalent to 100 tickets. A year later, after getting her 10 percent interest, she has $1,100. How many tickets can she buy now? The answer depends on what has happened to the price of a ticket. Here are a few scenarios:

- Zero inflation: If the price of a ticket remains at $10, the amount she can buy has risen from 100 to 110 tickets. The 10 percent increase in the number of dollars means a 10 percent increase in her purchasing power.
- Six percent inflation: If the price of a ticket rises from $10 to $10.60, then the number of tickets she can buy has risen from 100 to approximately 104. Her purchasing power has increased by about 4 percent.
- Ten percent inflation: If the price of a ticket rises from $10 to $11, she can still buy only 100 tickets. Even though Sara's dollar wealth has risen, her purchasing power is the same as it was a year earlier.
- Twelve percent inflation: If the price of a ticket increases from $10 to $11.20, the number of tickets she can buy has fallen from 100 to approximately 98. Even with her greater number of dollars, her purchasing power has decreased by about 2 percent.

And if Sara were living in an economy with deflation—negative inflation or, more simply, falling prices—another possibility could arise:

- Two percent deflation: If the price of a ticket falls from $10 to $9.80, then the number of tickets she can buy rises from 100 to approximately 112. Her purchasing power increases by about 12 percent.

These examples show that the higher the rate of inflation, the smaller the increase in Sara's purchasing power. If the rate of inflation exceeds the rate of interest, her purchasing power actually falls. And if there is deflation, her purchasing power rises by more than the rate of interest.

To understand how much a person earns in a savings account, we need to consider both the interest rate and the change in prices. The interest rate that measures the change in dollar amounts is called the **nominal interest rate**, and the interest rate corrected for inflation is called the **real interest rate**. The nominal interest rate, the real interest rate, and inflation are related approximately as follows:

nominal interest rate
the interest rate as usually reported without a correction for the effects of inflation

real interest rate
the interest rate corrected for the effects of inflation

$$\text{Real interest rate} = \text{Nominal interest rate} - \text{Inflation rate}.$$

The real interest rate is the difference between the nominal interest rate and the rate of inflation. The nominal interest rate tells you how fast the number of dollars in your bank account rises over time, while the real interest rate tells you how fast the purchasing power of your bank account rises over time.

CASE STUDY

INTEREST RATES IN THE U.S. ECONOMY

Figure 4 shows real and nominal interest rates in the U.S. economy since 1965. The nominal interest rate in this figure is the rate on three-month Treasury bills (although data on other interest rates would be similar). The real interest rate is computed by subtracting the rate of inflation from this nominal interest rate. Here the inflation rate is measured as the percentage change in the CPI.

One feature of this figure is that the nominal interest rate almost always exceeds the real interest rate. This reflects the fact that the U.S. economy has experienced rising consumer prices in almost every year during this period. By contrast, if you look at data for the U.S. economy during the late 19th century or for the Japanese economy in some recent years, you will find periods of deflation. During deflation, the real interest rate exceeds the nominal interest rate.

The figure also shows that because inflation is variable, real and nominal interest rates do not always move together. For example, in the late 1970s, nominal interest rates were high. But because inflation was very high, real interest rates were low. Indeed, during much of the 1970s, real interest rates were negative, for inflation eroded people's savings more quickly than nominal interest payments increased them. By contrast, in the late 1990s, nominal interest rates were lower than they had been two decades earlier. But because inflation was much lower, real interest rates were higher. In the coming chapters, we will examine the economic forces that determine both real and nominal interest rates. ●

FIGURE 4

Real and Nominal Interest Rates

This figure shows nominal and real interest rates using annual data since 1965. The nominal interest rate is the rate on a three-month Treasury bill. The real interest rate is the nominal interest rate minus the inflation rate as measured by the CPI. Notice that nominal and real interest rates often do not move together.

Source: U.S. Department of Labor; U.S. Department of Treasury.

QuickQuiz

5. If the CPI is 200 for the year 1980 and 300 today, then $600 in 1980 has the same purchasing power as _____ has today.
   a. $400
   b. $500
   c. $700
   d. $900

6. The main reason the cost of living varies across regions of the country is differences in the price of
   a. food.
   b. clothing.
   c. housing.
   d. medical care.

7. You deposit $2,000 in a savings account, and a year later you have $2,100. Meanwhile, the CPI rises from 200 to 204. In this case, the nominal interest rate is _____ percent, and the real interest rate is _____ percent.
   a. 1; 5
   b. 3; 5
   c. 5; 1
   d. 5; 3

Answers at end of chapter.

24-3 Conclusion

"A nickel ain't worth a dime anymore," the late, great baseball player Yogi Berra once observed. Indeed, throughout recent history, the real values behind the nickel, dime, and dollar have not been stable. Persistent increases in the overall level of prices have been the norm. Such inflation reduces the purchasing power of each unit of money over time. When comparing dollar figures from different times, it is important to keep in mind that a dollar today is not worth the same as a dollar 20 years ago or, most likely, 20 years from now.

This chapter has discussed how economists measure the overall level of prices in the economy and how they use price indexes to correct economic variables for the effects of inflation. Price indexes allow us to compare dollar figures from different points in time and, therefore, get a better sense of how the economy is changing.

The discussion of price indexes in this chapter, together with the preceding chapter's discussion of GDP, is only the first step in the study of macroeconomics. We have not yet examined what determines a nation's GDP or the causes and effects of inflation. To do that, we need to go beyond issues of measurement. Indeed, that is our next task. Having explained how economists measure macroeconomic quantities and prices in the past two chapters, we are now ready to develop the models that explain movements in these variables.

Here is our strategy in the upcoming chapters. First, we look at the long-run determinants of real GDP and related variables, such as saving, investment, real interest rates, and unemployment. Second, we look at the long-run determinants of the price level and related variables, such as the money supply, inflation, and nominal interest rates. Last of all, having seen how these variables are determined in the long run, we examine the more complex question of what causes short-run fluctuations in real GDP and the price level. In all of these chapters, the measurement issues we have just discussed will provide the foundation for the analysis.

CHAPTER IN A NUTSHELL

- The consumer price index (CPI) shows the cost of a basket of goods and services relative to the cost of the same basket in the base year. The index is used to measure the overall level of prices in the economy. The percentage change in the CPI measures the inflation rate.
- The CPI is an imperfect measure of the cost of living for three reasons. First, it does not take into account consumers' ability to substitute toward goods that become relatively cheaper over time. Second, it does not take into account increases in the purchasing power of the dollar that result from the introduction of new goods. Third, it is distorted by unmeasured changes in the quality of goods and services. Because of these measurement problems, the CPI overstates true inflation.
- Like the CPI, the GDP deflator measures the overall level of prices in the economy. The two price indexes usually move together, but there are important differences. The GDP deflator differs from the CPI because it reflects the prices of goods and services produced domestically rather than of goods and services bought by consumers. As a result, imported goods affect the CPI but not the GDP deflator. In addition, while the CPI uses a fixed basket of goods, the group of goods and services reflected in the GDP deflator automatically changes over time as the composition of GDP changes.
- Dollar figures from different times do not represent a valid comparison of purchasing power. To compare a dollar figure from the past with a dollar figure today, the older figure should be inflated using a price index.
- Various laws and private contracts use price indexes to correct for the effects of inflation. Tax laws, however, are only partially indexed for inflation.
- Correcting for inflation is especially important when looking at data on interest rates. The nominal interest rate—the interest rate usually reported—is the rate at which the number of dollars in a savings account increases over time. By contrast, the real interest rate is the rate at which the purchasing power of a savings account increases over time. The real interest rate equals the nominal interest rate minus the rate of inflation.

KEY CONCEPTS

consumer price index (CPI), *p. 488*
inflation rate, *p. 490*
core CPI, *p. 490*
producer price index (PPI), *p. 491*
indexation, *p. 497*
nominal interest rate, *p. 498*
real interest rate, *p. 498*

QUESTIONS FOR REVIEW

1. Which do you think has a greater effect on the CPI: a 10 percent increase in the price of chicken or a 10 percent increase in the price of caviar? Why?
2. Describe the three problems that make the CPI an imperfect measure of the cost of living.
3. Does an increase in the price of imported French wine affect the CPI or the GDP deflator more? Why?
4. Over a long period of time, the price of a candy bar rose from \$0.20 to \$1.20. Over the same period, the CPI rose from 150 to 300. Adjusted for overall inflation, how much did the price of the candy bar change?
5. Explain the meanings of *nominal interest rate* and *real interest rate*. How are they related?

PROBLEMS AND APPLICATIONS

1. Suppose that the year you were born someone bought $100 of goods and services for your baby shower. How much would you guess it would cost today to buy a similar amount of goods and services? Now find data on the CPI and compute the answer based on it. (You can find the BLS's inflation calculator here: http://www.bls.gov/data/inflation_calculator.htm.)
2. The residents of Vegopia spend all of their income on cauliflower, broccoli, and carrots. In 2020, they spend a total of $200 for 100 heads of cauliflower, $75 for 50 bunches of broccoli, and $50 for 500 carrots. In 2021, they spend a total of $225 for 75 heads of cauliflower, $120 for 80 bunches of broccoli, and $100 for 500 carrots.
   a. Calculate the price of one unit of each vegetable in each year.
   b. Using 2020 as the base year, calculate the CPI for each year.
   c. What is the inflation rate in 2021?
3. Suppose that people consume only three goods, as shown in this table:

	Tennis Balls	Golf Balls	Bottles of Gatorade
2020 price	$2	$4	$1
2020 quantity	100	100	200
2021 price	$2	$6	$2
2021 quantity	100	100	200

   a. What is the percentage change in the price of each of the three goods?
   b. Using a method similar to the CPI, compute the percentage change in the overall price level.
   c. If you were to learn that a bottle of Gatorade increased in size from 2020 to 2021, should that information affect your calculation of the inflation rate? If so, how?
   d. If you were to learn that Gatorade introduced new flavors in 2021, should that information affect your calculation of the inflation rate? If so, how?
4. Go to the website of the Bureau of Labor Statistics (http://www.bls.gov) and find data on the CPI. By how much has the index including all items risen over the past year? For which categories of spending have prices risen the most? The least? Have any categories experienced price declines? Can you explain any of these facts?
5. A small nation idolizes the TV show *The Voice*. All they produce and consume are karaoke machines and CDs, in the following amounts:

	Karaoke Machines		CDs	
	Quantity	Price	Quantity	Price
2020	10	$40	30	$10
2021	12	60	50	12

   a. Using a method similar to the CPI, compute the percentage change in the overall price level. Use 2020 as the base year and fix the basket at 1 karaoke machine and 3 CDs.
   b. Using a method similar to the GDP deflator, compute the percentage change in the overall price level. Again, use 2020 as the base year.
   c. Is the inflation rate in 2021 the same using the two methods? Explain why or why not.
6. Which of the problems in the construction of the CPI might be illustrated by each of the following situations? Explain.
   a. the invention of cell phones
   b. the introduction of air bags in cars
   c. increased personal computer purchases in response to a decline in their price
   d. more scoops of raisins in each package of Raisin Bran
   e. greater use of fuel-efficient cars after gasoline prices increase
7. A dozen eggs cost $0.88 in January 1980 and $1.77 in January 2018. The average hourly wage for production and nonsupervisory workers was $6.57 in January 1980 and $22.36 in January 2018.
   a. By what percentage did the price of eggs rise?
   b. By what percentage did the wage rise?
   c. In each year, how many minutes did a worker have to work to earn enough to buy a dozen eggs?
   d. Did workers' purchasing power in terms of eggs rise or fall?
8. The chapter explains that Social Security benefits are increased each year in proportion to the increase in the CPI, even though most economists believe that the CPI overstates actual inflation.
   a. If the elderly consume the same market basket as other people, does Social Security provide the elderly with an improvement in their standard of living each year? Explain.
   b. In fact, the elderly consume more healthcare compared with younger people, and healthcare costs have risen faster than overall inflation. What would you do to determine whether the elderly are actually better off from year to year?

9. Suppose that a borrower and a lender agree on the nominal interest rate to be paid on a loan. Then inflation turns out to be higher than they both expected.
   a. Is the real interest rate on this loan higher or lower than expected?
   b. Does the lender gain or lose from this unexpectedly high inflation? Does the borrower gain or lose?
   c. Inflation during the 1970s was much higher than most people had expected when the decade began. How did this unexpectedly high inflation affect homeowners who obtained fixed-rate mortgages during the 1960s? How did it affect the banks that lent the money?

QuickQuiz Answers

1. **c** 2. **b** 3. **d** 4. **a** 5. **d** 6. **c** 7. **d**