After studying this chapter, you will be able to:

- Define GDP and use the circular flow model to explain why GDP equals aggregate expenditure and aggregate income
- Explain how the Bureau of Economic Analysis measures U.S. GDP and real GDP
- Describe how real GDP is used to measure economic growth and fluctuations and explain the limitations of real GDP as a measure of economic well-being

4

MEASURING GDP AND ECONOMIC GROWTH

Will our economy expand more rapidly in 2011 or will it sink into another recession—a "double-dip"? Many U.S. corporations wanted to know the answers to these questions at the beginning of 2011. Google wanted to know whether to expand its server network and introduce new services or hold off on any new launches. Amazon.com wanted to know whether to increase its warehousing facilities. To assess the state of the economy and to make big decisions about business expansion, firms such as Google and Amazon use forecasts of GDP. What exactly is GDP and what does it tell us about the state of the economy?

Some countries are rich while others are poor. How do we compare economic well-being in one country with that in another? How can we make international comparisons of production?

In this chapter, you will find out how economic statisticians at the Bureau of Economic Analysis measure GDP and the economic growth rate. You will also learn about the uses and the limitations of these measures. In *Reading Between the Lines* at the end of the chapter, we'll look at some future scenarios for the U.S. economy.

Gross Domestic Product

What exactly is GDP, how is it calculated, what does it mean, and why do we care about it? You are going to discover the answers to these questions in this chapter. First, what *is* GDP?

GDP Defined

GDP, or **gross domestic product**, is the market value of the final goods and services produced within a country in a given time period. This definition has four parts:

- Market value
- Final goods and services
- Produced within a country
- In a given time period

We'll examine each in turn.

Market Value To measure total production, we must add together the production of apples and oranges, computers and popcorn. Just counting the items doesn't get us very far. For example, which is the greater total production: 100 apples and 50 oranges or 50 apples and 100 oranges?

GDP answers this question by valuing items at their *market values*—the prices at which items are traded in markets. If the price of an apple is 10 cents, then the market value of 50 apples is $5. If the price of an orange is 20 cents, then the market value of 100 oranges is $20. By using market prices to value production, we can add the apples and oranges together. The market value of 50 apples and 100 oranges is $5 plus $20, or $25.

Final Goods and Services To calculate GDP, we value the *final goods and services* produced. A **final good** (or service) is an item that is bought by its final user during a specified time period. It contrasts with an **intermediate good** (or service), which is an item that is produced by one firm, bought by another firm, and used as a component of a final good or service.

For example, a Ford truck is a final good, but a Firestone tire on the truck is an intermediate good. A Dell computer is a final good, but an Intel Pentium chip inside it is an intermediate good.

If we were to add the value of intermediate goods and services produced to the value of final goods and services, we would count the same thing many times—a problem called *double counting*. The value of a truck already includes the value of the tires, and the value of a Dell PC already includes the value of the Pentium chip inside it.

Some goods can be an intermediate good in some situations and a final good in other situations. For example, the ice cream that you buy on a hot summer day is a final good, but the ice cream that a restaurant buys and uses to make sundaes is an intermediate good. The sundae is the final good. So whether a good is an intermediate good or a final good depends on what it is used for, not what it is.

Some items that people buy are neither final goods nor intermediate goods and they are not part of GDP. Examples of such items include financial assets—stocks and bonds—and secondhand goods—used cars or existing homes. A secondhand good was part of GDP in the year in which it was produced, but not in GDP this year.

Produced Within a Country Only goods and services that are produced *within a country* count as part of that country's GDP. Nike Corporation, a U.S. firm, produces sneakers in Vietnam, and the market value of those shoes is part of Vietnam's GDP, not part of U.S. GDP. Toyota, a Japanese firm, produces automobiles in Georgetown, Kentucky, and the value of this production is part of U.S. GDP, not part of Japan's GDP.

In a Given Time Period GDP measures the value of production *in a given time period*—normally either a quarter of a year—called the quarterly GDP data—or a year—called the annual GDP data.

GDP measures not only the value of total production but also total income and total expenditure. The equality between the value of total production and total income is important because it shows the direct link between productivity and living standards. Our standard of living rises when our incomes rise and we can afford to buy more goods and services. But we must produce more goods and services if we are to be able to buy more goods and services.

Rising incomes and a rising value of production go together. They are two aspects of the same phenomenon: increasing productivity. To see why, we study the circular flow of expenditure and income.

GDP and the Circular Flow of Expenditure and Income

Figure 4.1 illustrates the circular flow of expenditure and income. The economy consists of households, firms, governments, and the rest of the world (the rectangles), which trade in factor markets and goods (and services) markets. We focus first on households and firms.

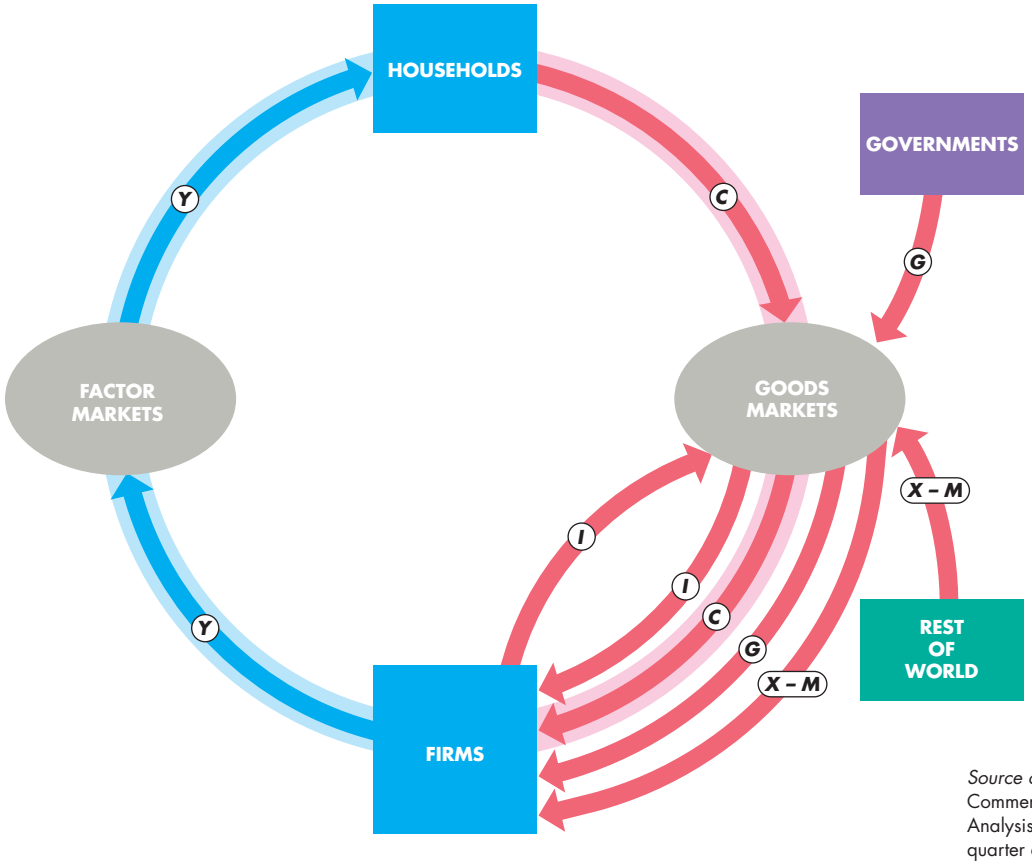
Households and Firms Households sell and firms buy the services of labor, capital, and land in factor markets. For these factor services, firms pay income to households: wages for labor services, interest for the use of capital, and rent for the use of land. A fourth factor of production, entrepreneurship, receives profit.

Firms' retained earnings—profits that are not distributed to households—are part of the household sector's income. You can think of retained earnings as being income that households save and lend back to firms. Figure 4.1 shows the total income—*aggregate income*—received by households, including retained earnings, as the blue flow labeled *Y*.

Firms sell and households buy consumer goods and services—such as inline skates and haircuts—in the goods market. The total payment for these goods and services is **consumption expenditure**, shown by the red flow labeled *C*.

Firms buy and sell new capital equipment—such as computer systems, airplanes, trucks, and assembly line equipment—in the goods market. Some of what firms produce is not sold but is added to inventory. For example, if GM produces 1,000 cars and sells 950 of them, the other 50 cars remain in GM's inventory of unsold cars, which increases by 50 cars. When a firm adds unsold output to inventory, we can think of the firm as buying goods from itself. The

FIGURE 4.1 The Circular Flow of Expenditure and Income



Households make consumption expenditures (*C*); firms make investments (*I*); governments buy goods and services (*G*); and the rest of the world buys net exports (*X* – *M*). Firms pay incomes (*Y*) to households. Aggregate income equals aggregate expenditure.

Billions of dollars in 2010	
C =	10,285
I =	1,842
G =	2,991
X – *M* =	–539
Y =	14,579

Source of data: U.S. Department of Commerce, Bureau of Economic Analysis. (The data are for the second quarter of 2010 annual rate.)

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purchase of new plant, equipment, and buildings and the additions to inventories are **investment**, shown by the red flow labeled *I*.

Governments Governments buy goods and services from firms and their expenditure on goods and services is called **government expenditure**. In Fig. 4.1, government expenditure is shown as the red flow *G*.

Governments finance their expenditure with taxes. But taxes are not part of the circular flow of expenditure and income. Governments also make financial transfers to households, such as Social Security benefits and unemployment benefits, and pay subsidies to firms. These financial transfers, like taxes, are not part of the circular flow of expenditure and income.

Rest of the World Firms in the United States sell goods and services to the rest of the world—**exports**—and buy goods and services from the rest of the world—**imports**. The value of exports (X) minus the value of imports (M) is called **net exports**, the red flow $X - M$ in Fig 4.1. If net exports are positive, the net flow of goods and services is from U.S. firms to the rest of the world. If net exports are negative, the net flow of goods and services is from the rest of the world to U.S. firms.

GDP Equals Expenditure Equals Income Gross domestic product can be measured in two ways: By the total expenditure on goods and services or by the total income earned producing goods and services.

The total expenditure—*aggregate expenditure*—is the sum of the red flows in Fig. 4.1. Aggregate expenditure equals consumption expenditure plus investment plus government expenditure plus net exports.

Aggregate income is equal to the total amount paid for the services of the factors of production used to produce final goods and services—wages, interest, rent, and profit. The blue flow in Fig. 4.1 shows aggregate income. Because firms pay out as incomes (including retained profits) everything they receive from the sale of their output, aggregate income (the blue flow) equals aggregate expenditure (the sum of the red flows). That is,

$$Y = C + I + G + X - M.$$

The table in Fig. 4.1 shows the values of the expenditures for 2010 and that their sum is $14,579 billion, which also equals aggregate income.

Because aggregate expenditure equals aggregate income, the two methods of measuring GDP give the same answer. So

GDP equals aggregate expenditure and equals aggregate income.

The circular flow model is the foundation on which the national economic accounts are built.

Why Is Domestic Product "Gross"?

"Gross" means before subtracting the depreciation of capital. The opposite of "gross" is "net," which means after subtracting the depreciation of capital.

Depreciation is the decrease in the value of a firm's capital that results from wear and tear and obsolescence. The total amount spent both buying new capital and replacing depreciated capital is called **gross investment**. The amount by which the value of capital increases is called **net investment**. Net investment equals gross investment minus depreciation.

For example, if an airline buys 5 new airplanes and retires 2 old airplanes from service, its gross investment is the value of the 5 new airplanes, depreciation is the value of the 2 old airplanes retired, and net investment is the value of 3 new airplanes.

Gross investment is one of the expenditures included in the expenditure approach to measuring GDP. So the resulting value of total product is a gross measure.

Gross profit, which is a firm's profit before subtracting depreciation, is one of the incomes included in the income approach to measuring GDP. So again, the resulting value of total product is a gross measure.

REVIEW QUIZ

1 Define GDP and distinguish between a final good and an intermediate good. Provide examples.
2 Why does GDP equal aggregate income and also equal aggregate expenditure?
3 What is the distinction between gross and net?

You can work these questions in Study Plan 4.1 and get instant feedback.

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Let's now see how the ideas that you've just studied are used in practice. We'll see how GDP and its components are measured in the United States today.

Measuring U.S. GDP

The Bureau of Economic Analysis (BEA) uses the concepts in the circular flow model to measure GDP and its components in the *National Income and Product Accounts.* Because the value of aggregate production equals aggregate expenditure and aggregate income, there are two approaches available for measuring GDP, and both are used. They are

- The expenditure approach
- The income approach

The Expenditure Approach

The *expenditure approach* measures GDP as the sum of consumption expenditure (C), investment (I), government expenditure on goods and services (G), and net exports of goods and services ($X - M$). These expenditures correspond to the red flows through the goods markets in the circular flow model in Fig. 4.1. Table 4.1 shows these expenditures and GDP for 2010. The table uses the terms in the *National Income and Product Accounts*.

Personal consumption expenditures are the expenditures by U.S. households on goods and services produced in the United States and in the rest of the world. They include goods such as soda and books and services such as banking and legal advice. They also include the purchase of consumer durable goods, such as TVs and microwave ovens. But they do *not* include the purchase of new homes, which the BEA counts as part of investment.

Gross private domestic investment is expenditure on capital equipment and buildings by firms and the additions to business inventories. It also includes expenditure on new homes by households.

Government expenditure on goods and services is the expenditure by all levels of government on goods and services, such as national defense and garbage collection. It does *not* include *transfer payments*, such as unemployment benefits, because they are not expenditures on goods and services.

Net exports of goods and services are the value of exports minus the value of imports. This item includes airplanes that Boeing sells to British Airways (a U.S. export), and Japanese DVD players that Circuit City buys from Sony (a U.S. import).

Table 4.1 shows the relative magnitudes of the four items of aggregate expenditure.

TABLE 4.1 GDP: The Expenditure Approach

Item	Symbol	Amount in 2010 (billions of dollars)	Percentage of GDP
Personal consumption expenditures	C	10,285	70.5
Gross private domestic investment	I	1,842	12.6
Government expenditure on goods and services	G	2,991	20.5
Net exports of goods and services	$X - M$	–539	–3.7
Gross domestic product	Y	**14,579**	**100.0**

The expenditure approach measures GDP as the sum of personal consumption expenditures (C), gross private domestic investment (I), government expenditure on goods and services (G), and net exports ($X - M$). In 2010, GDP measured by the expenditure approach was $14,579 billion. More than two thirds of aggregate expenditure is on personal consumption goods and services.

Source of data: U.S. Department of Commerce, Bureau of Economic Analysis.

The Income Approach

The *income approach* measures GDP by summing the incomes that firms pay households for the services of the factors of production they hire—wages for labor, interest for capital, rent for land, and profit for entrepreneurship. These incomes correspond to the blue flow through the factor markets in the circular flow model in Fig. 4.1.

The *National Income and Product Accounts* divide incomes into two big categories:

1. Compensation of employees
2. Net operating surplus

Compensation of employees is the payment for labor services. It includes net wages and salaries (called "take-home pay") that workers receive plus taxes withheld on earnings plus fringe benefits such as Social Security and pension fund contributions.

Net operating surplus is the sum of all other factor incomes. It has four components: *net interest*, *rental*

income, *corporate profits*, and *proprietors' income*.

Net interest is the interest households receive on loans they make minus the interest households pay on their own borrowing.

Rental income is the payment for the use of land and other rented resources.

Corporate profits are the profits of corporations, some of which are paid to households in the form of dividends and some of which are retained by corporations as undistributed profits. They are all income.

Proprietors' income is the income earned by the owner-operator of a business, which includes compensation for the owner's labor, the use of the owner's capital, and profit.

Table 4.2 shows the two big categories of factor incomes and their relative magnitudes. You can see that compensation of employees—labor income—is approximately twice the magnitude of the other factor incomes that make up the net operating surplus.

The factor incomes sum to *net domestic income at factor cost*. The term "factor cost" is used because it is the cost of the factors of production used to produce final goods. When we sum the expenditures on final goods, we arrive at a total called *domestic product at market prices*. Market prices and factor cost diverge because of indirect taxes and subsidies.

An *indirect tax* is a tax paid by consumers when they buy goods and services. (In contrast, a *direct tax* is a tax on income.) State sales taxes and taxes on alcohol, gasoline, and tobacco products are indirect taxes. Because of indirect taxes, consumers pay more for some goods and services than producers receive. Market price exceeds factor cost. For example, if the sales tax is 7 percent, you pay $1.07 when you buy a $1 chocolate bar. The factor cost of the chocolate bar including profit is $1. The market price is $1.07.

A *subsidy* is a payment by the government to a producer. Payments made to grain growers and dairy farmers are subsidies. Because of subsidies, consumers pay less for some goods and services than producers receive. Factor cost exceeds market price.

To get from factor cost to market price, we add indirect taxes and subtract subsidies. Making this adjustment brings us to *net domestic income at market prices*. We still must get from a *net* to a *gross* measure.

Total expenditure is a *gross* number because it includes *gross* investment. Net domestic income at market prices is a net income measure because corporate profits are measured *after deducting depreciation*. They are a *net* income measure. To get from net income to gross income, we must *add depreciation*.

TABLE 4.2 GDP: The Income Approach

Item	Amount in 2010 (billions of dollars)	Percentage of GDP
Compensation of employees	7,929	54.4
Net interest	924	6.3
Rental income	299	2.1
Corporate profits	1,210	8.3
Proprietors' income	1,050	7.2
Net domestic income at factor cost	11,412	78.3
Indirect taxes *less* subsidies	1,127	7.7
Net domestic income at market prices	12,539	86.0
Depreciation	1,860	12.8
GDP (income approach)	**14,399**	**98.8**
Statistical discrepancy	180	1.2
GDP (expenditure approach)	**14,579**	**100.0**

The sum of factor incomes equals *net domestic income at factor cost*. GDP equals net domestic income at factor cost plus indirect taxes less subsidies plus depreciation.

In 2010, GDP measured by the income approach was $14,399 billion. This amount is $180 billion less than GDP measured by the expenditure approach—a statistical discrepancy of $151 billion or 1.2 percent of GDP.

Compensation of employees—labor income—is by far the largest part of aggregate income.

Source of data: U.S. Department of Commerce, Bureau of Economic Analysis.

We've now arrived at GDP using the income approach. This number is not exactly the same as GDP using the expenditure approach. For example, if a waiter doesn't report all his tips when he fills out his income tax return, they get missed in the income approach but they show up in the expenditure approach when he spends his income. So the sum of expenditures might exceed the sum of incomes. Also the sum of expenditures might exceed the sum of incomes because some expenditure items are estimated rather than directly measured.

The gap between the expenditure approach and the income approach is called the *statistical discrepancy* and it is calculated as the GDP expenditure total minus the GDP income total. The discrepancy is never large. In 2010, it was 1.2 percent of GDP.

Nominal GDP and Real GDP

Often, we want to *compare* GDP in two periods, say 2000 and 2010. In 2000, GDP was $9,952 billion and in 2010, it was $14,579 billion—46 percent higher than in 2000. This increase in GDP is a combination of an increase in production and a rise in prices. To isolate the increase in production from the rise in prices, we distinguish between *real* GDP and *nominal* GDP.

Real GDP is the value of final goods and services produced in a given year when *valued at the prices of a reference base year*. By comparing the value of production in the two years at the same prices, we reveal the change in production.

Currently, the reference base year is 2005 and we describe real GDP as measured in 2005 dollars—in terms of what the dollar would buy in 2005.

Nominal GDP is the value of final goods and services produced in a given year when valued at the prices of that year. Nominal GDP is just a more precise name for GDP.

Economists at the Bureau of Economic Analysis calculate real GDP using the method described in the Mathematical Note on pp. 100–101. Here, we'll explain the basic idea but not the technical details.

Calculating Real GDP

We'll calculate real GDP for an economy that produces one consumption good, one capital good, and one government service. Net exports are zero.

Table 4.3 shows the quantities produced and the prices in 2005 (the base year) and in 2010. In part (a), we calculate nominal GDP in 2005. For each item, we multiply the quantity produced in 2005 by its price in 2005 to find the total expenditure on the item. We sum the expenditures to find nominal GDP, which in 2005 is $100 million. Because 2005 is the base year, both real GDP and nominal GDP equal $100 million.

In Table 4.3(b), we calculate nominal GDP in 2010, which is $300 million. Nominal GDP in 2010 is three times its value in 2005. But by how much has production increased? Real GDP will tell us.

In Table 4.3(c), we calculate real GDP in 2010. The quantities of the goods and services produced are those of 2010, as in part (b). The prices are those in the reference base year—2005, as in part (a).

For each item, we multiply the quantity produced in 2010 by its price in 2005. We then sum these expenditures to find real GDP in 2010, which is $160 million. This number is what total expenditure would have been in 2010 if prices had remained the same as they were in 2005.

Nominal GDP in 2010 is three times its value in 2005, but real GDP in 2010 is only 1.6 times its 2005 value—a 60 percent increase in production.

TABLE 4.3 Calculating Nominal GDP and Real GDP

	Item	Quantity (millions)	Price (dollars)	Expenditure (millions of dollars)
(a) In 2005				
C	T-shirts	10	5	50
I	Computer chips	3	10	30
G	Security services	1	20	20
Y	Real and Nominal GDP in 2005			100
(b) In 2010				
C	T-shirts	4	5	20
I	Computer chips	2	20	40
G	Security services	6	40	240
Y	Nominal GDP in 2010			300
(c) Quantities of 2010 valued at prices of 2005				
C	T-shirts	4	5	20
I	Computer chips	2	10	20
G	Security services	6	20	120
Y	Real GDP in 2010			160

In 2005, the reference base year, real GDP equals nominal GDP and was $100 million. In 2010, nominal GDP increased to $300 million. But real GDP in 2010 in part (c), which is calculated by using the quantities of 2010 in part (b) and the prices of 2005 in part (a), was only $160 million—a 60 percent increase from 2005.

REVIEW QUIZ

1. What is the expenditure approach to measuring GDP?
2. What is the income approach to measuring GDP?
3. What adjustments must be made to total income to make it equal GDP?
4. What is the distinction between nominal GDP and real GDP?
5. How is real GDP calculated?

You can work these questions in Study Plan 4.2 and get instant feedback.

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The Uses and Limitations of Real GDP

Economists use estimates of real GDP for two main purposes:

- To compare the standard of living over time
- To compare the standard of living across countries

The Standard of Living Over Time

One method of comparing the standard of living over time is to calculate real GDP per person in different years. **Real GDP per person** is real GDP divided by the population. Real GDP per person tells us the value of goods and services that the average person can enjoy. By using *real* GDP, we remove any influence that rising prices and a rising cost of living might have had on our comparison.

We're interested in both the long-term trends and the shorter-term cycles in the standard of living.

Long-Term Trend A handy way of comparing real GDP per person over time is to express it as a ratio of some reference year. For example, in 1960, real GDP per person was $15,850 and in 2010, it was $42,800. So real GDP per person in 2010 was 2.7 times its 1960 level—that is, $42,800 ÷ $15,850 = 2.7. To the extent that real GDP per person measures the standard of living, people were 2.7 times as well off in 2010 as their grandparents had been in 1960.

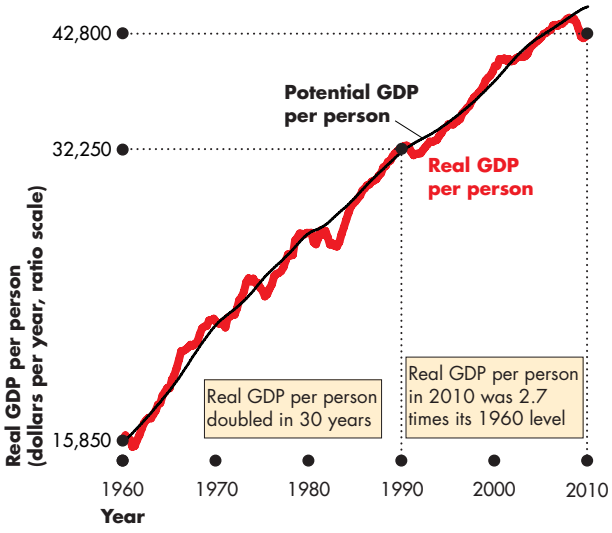
Figure 4.2 shows the path of U.S. real GDP per person for the 50 years from 1960 to 2010 and highlights two features of our expanding living standard:

- The growth of potential GDP per person
- Fluctuations of real GDP per person

The Growth of Potential GDP **Potential GDP** is the maximum level of real GDP that can be produced while avoiding shortages of labor, capital, land, and entrepreneurial ability that would bring rising inflation. Potential GDP per person, the smoother black line in Fig. 4.2, grows at a steady pace because the quantities of the factors of production and their productivities grow at a steady pace.

But potential GDP per person doesn't grow at a *constant* pace. During the 1960s, it grew at 2.8 percent per year but slowed to only 2.3 percent per year during the 1970s. This slowdown might seem small, but it had big consequences, as you'll soon see.

FIGURE 4.2 Rising Standard of Living in the United States



Real GDP per person in the United States doubled between 1960 and 1990. In 2010, real GDP per person was 2.7 times its 1960 level. Real GDP per person, the red line, fluctuates around potential GDP per person, the black line. (The *y*-axis is a ratio scale—see the Appendix, pp, 504–505.)

Sources of data: U.S. Department of Commerce, Bureau of Economic Analysis and Congressional Budget Office.

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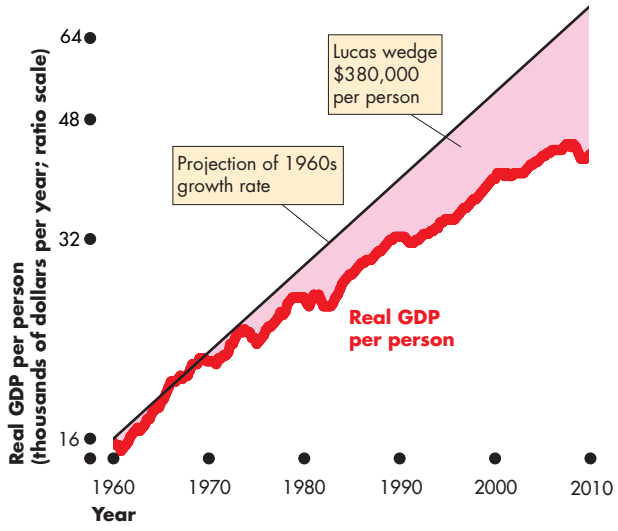
Fluctuations of Real GDP You can see that real GDP shown by the red line in Fig. 4.2 fluctuates around potential GDP, and sometimes real GDP shrinks.

Let's take a closer look at the two features of our expanding living standard that we've just outlined.

Productivity Growth Slowdown How costly was the slowdown in productivity growth after 1970? The answer is provided by the *Lucas wedge*, which is the dollar value of the accumulated gap between what real GDP per person would have been if the 1960s growth rate had persisted and what real GDP per person turned out to be. (Nobel Laureate Robert E. Lucas Jr. drew attention to this gap.)

Figure 4.3 illustrates the Lucas wedge. The wedge started out small during the 1970s, but by 2010 real GDP per person was $28,400 per year lower than it would have been with no growth slowdown, and the accumulated gap was an astonishing $380,000 per person.

FIGURE 4.3 The Cost of Slower Growth: The Lucas Wedge



The black line projects the 1960s growth rate of real GDP per person to 2010. The Lucas wedge arises from the slowdown of productivity growth that began during the 1970s. The cost of the slowdown is $380,000 per person.

Sources of data: U.S. Department of Commerce Bureau of Economic Analysis, Congressional Budget Office, and author's calculations.

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Real GDP Fluctuations—The Business Cycle We call the fluctuations in the pace of expansion of real GDP the business cycle. The **business cycle** is a periodic but irregular up-and-down movement of total production and other measures of economic activity. The business cycle isn't a regular predictable cycle like the phases of the moon, but every cycle has two phases:

1. Expansion
2. Recession

and two turning points:

1. Peak
2. Trough

Figure 4.4 shows these features of the most recent U.S. business cycle.

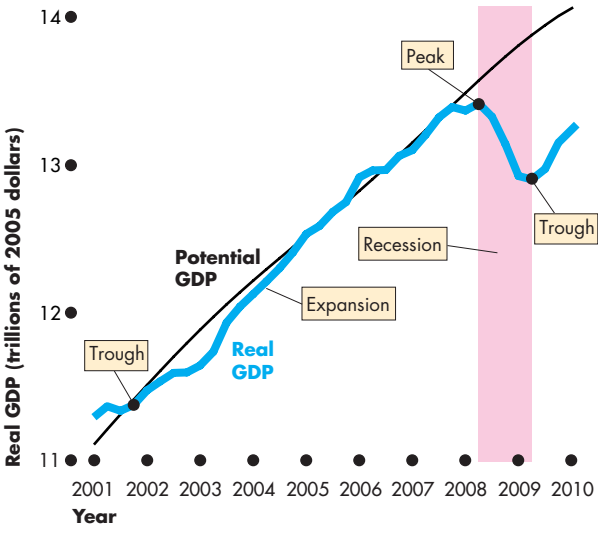
An **expansion** is a period during which real GDP increases. In the early stage of an expansion real GDP returns to potential GDP and as the expansion progresses, potential GDP grows and real GDP eventually exceeds potential GDP.

A common definition of **recession** is a period during which real GDP decreases—its growth rate is negative—for at least two successive quarters. The definition used by the National Bureau of Economic Research, which dates the U.S. business cycle phases and turning points, is "a period of significant decline in total output, income, employment, and trade, usually lasting from six months to a year, and marked by contractions in many sectors of the economy."

An expansion ends and recession begins at a business cycle *peak*, which is the highest level that real GDP has attained up to that time. A recession ends at a *trough*, when real GDP reaches a temporary low point and from which the next expansion begins.

In 2008, the U.S. economy went into an unusually severe recession. Starting from a long way below potential GDP, a new expansion began in mid-2009. But the outlook for the expansion in 2011 and beyond was very uncertain (see *Reading Between the Lines* on pp. 96–97).

FIGURE 4.4 The Most Recent U.S. Business Cycle



A business cycle expansion began from a trough in the fourth quarter of 2001 and ended at a peak in the second quarter of 2008. A deep and long recession followed the 2008 peak.

Sources of data: U.S. Department of Commerce Bureau of Economic Analysis, Congressional Budget Office, and National Bureau of Economic Research.

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The Standard of Living Across Countries

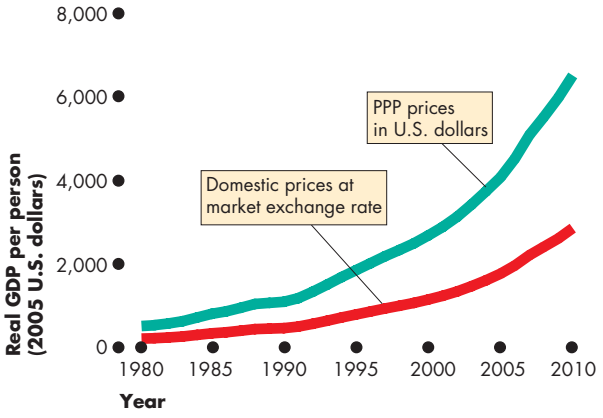
Two problems arise in using real GDP to compare living standards across countries. First, the real GDP of one country must be converted into the same currency units as the real GDP of the other country. Second, the goods and services in both countries must be valued at the same prices. Comparing the United States and China provides a striking example of these two problems.

China and the United States in U.S. Dollars In 2010, real GDP per person in the United States was $42,800 and in China it was 23,400 yuan. The yuan is the currency of China and the price at which the dollar and the yuan exchanged, the *market exchange rate*, was 8.2 yuan per $1 U.S. Using this exchange rate, 23,400 yuan converts to $2,850. On these numbers, real GDP per person in the United States was 15 times that in China.

The red line in Fig. 4.5 shows real GDP per person in China from 1980 to 2010 when the market exchange rate is used to convert yuan to U.S. dollars.

China and the United States at PPP Figure 4.5 shows a second estimate of China's real GDP per person that values China's production on the same terms as U.S. production. It uses *purchasing power parity* or *PPP* prices, which are the *same prices* for both countries.

FIGURE 4.5 Two Views of Real GDP in China



Real GDP per person in China has grown rapidly. But how rapidly it has grown and to what level depends on how real GDP is valued. When GDP in 2010 is valued at the market exchange rate, U.S. income per person is 15 times that in China. China looks like a poor developing country. But the comparison is misleading. When GDP is valued at purchasing power parity prices, U.S. income per person is only 6.5 times that in China.

Source of data: International Monetary Fund, *World Economic Outlook database*, April 2010 .

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A Big Mac costs $3.75 in Chicago and 13.25 yuan or $1.62 in Shanghai. To compare real GDP in China and the United States, we must value China's Big Macs at the $3.75 U.S. price—the PPP price.

The prices of some goods are higher in the United States than in China, so these items get a smaller weight in China's real GDP than they get in U.S. real GDP. An example is a Big Mac that costs $3.75 in Chicago. In Shanghai, a Big Mac costs 13.25 yuan which is the equivalent of $1.62. So in China's real GDP, a Big Mac gets less than half the weight that it gets in U.S. real GDP.

Some prices in China are higher than in the United States but more prices are lower, so Chinese prices put a lower value on China's production than do U.S. prices.

According to the PPP comparisons, real GDP per person in the United States in 2010 was 6.5 times that of China, not 15 times.

You've seen how real GDP is used to make standard of living comparisons over time and across countries. But real GDP isn't a perfect measure of the standard of living and we'll now examine its limitations.

Limitations of Real GDP

Real GDP measures the value of goods and services that are bought in markets. Some of the factors that influence the standard of living and that are not part of GDP are

- Household production
- Underground economic activity
- Health and life expectancy
- Leisure time
- Environmental quality
- Political freedom and social justice

Household Production An enormous amount of production takes place every day in our homes. Preparing meals, cleaning the kitchen, changing a light bulb, cutting grass, washing a car, and caring for a child are all examples of household production. Because these productive activities are not traded in markets, they are not included in GDP.

The omission of household production from GDP means that GDP *underestimates* total production. But it also means that the growth rate of GDP *overestimates* the growth rate of total production. The reason is that some of the growth rate of market production (included in GDP) is a replacement for home production. So part of the increase in GDP arises from a decrease in home production.

Two trends point in this direction. One is the number of women who have jobs, which increased from 38 percent in 1960 to 58 percent in 2010. The other is the trend in the market purchase of traditionally home-produced goods and services. For example, more and more families now eat in restaurants—one of the fastest-growing industries in the United States—and use day-care services. This trend means that an increasing proportion of food preparation and child care that were part of household production are now measured as part of GDP. So real GDP grows more rapidly than does real GDP plus home production.

Underground Economic Activity The *underground economy* is the part of the economy that is purposely hidden from the view of the government to avoid taxes and regulations or because the goods and services being produced are illegal. Because underground economic activity is unreported, it is omitted from GDP.

The underground economy is easy to describe, even if it is hard to measure. It includes the production and distribution of illegal drugs, production that uses illegal labor that is paid less than the minimum wage, and jobs done for cash to avoid paying income taxes. This last category might be quite large and includes tips earned by cab drivers, hairdressers, and hotel and restaurant workers.

Estimates of the scale of the underground economy in the United States range between 9 and 30 percent of GDP ($1,300 billion to $4,333 billion).

Provided that the underground economy is a stable proportion of the total economy, the growth rate of real GDP still gives a useful estimate of changes in economic well-being and the standard of living. But sometimes production shifts from the underground economy to the rest of the economy, and sometimes it shifts the other way. The underground economy expands relative to the rest of the economy if taxes

Whose production is more valuable: the chef's whose work gets counted in GDP ...

... or the busy mother's whose dinner preparation and child minding don't get counted?

become especially high or if regulations become especially restrictive. And the underground economy shrinks relative to the rest of the economy if the burdens of taxes and regulations are eased. During the 1980s, when tax rates were cut, there was an increase in the reporting of previously hidden income and tax revenues increased. So some part (but probably a very small part) of the expansion of real GDP during the 1980s represented a shift from the underground economy rather than an increase in production.

Health and Life Expectancy Good health and a long life—the hopes of everyone—do not show up in real GDP, at least not directly. A higher real GDP enables us to spend more on medical research, health care, a good diet, and exercise equipment. And as real GDP has increased, our life expectancy has lengthened—from 70 years at the end of World War II to approaching 80 years today.

But we face new health and life expectancy problems every year. AIDS and drug abuse are taking young lives at a rate that causes serious concern. When we take these negative influences into account, we see that real GDP growth overstates the improvements in the standard of living.

Leisure Time Leisure time is an economic good that adds to our economic well-being and the standard of living. Other things remaining the same, the more leisure we have, the better off we are. Our working time is valued as part of GDP, but our leisure time is not. Yet that leisure time must be at least as valuable to us as the wage that we earn for the last hour worked. If it were not, we would work instead of taking leisure. Over the years, leisure time has steadily increased. The workweek has become shorter, more people take early retirement, and the number of vacation days has increased. These improvements in economic well-being are not reflected in real GDP.

Environmental Quality Economic activity directly influences the quality of the environment. The burning of hydrocarbon fuels is the most visible activity that damages our environment. But it is not the only example. The depletion of nonrenewable natural resources, the mass clearing of forests, and the pollution of lakes and rivers are other major environmental consequences of industrial production.

Resources that are used to protect the environment are valued as part of GDP. For example, the value of catalytic converters that help to protect the atmosphere from automobile emissions is part of GDP. But if we did not use such pieces of equipment and instead polluted the atmosphere, we would not count the deteriorating air that we were breathing as a negative part of GDP.

An industrial society possibly produces more atmospheric pollution than an agricultural society does. But pollution does not always increase as we become wealthier. Wealthy people value a clean environment and are willing to pay for one. Compare the pollution in China today with pollution in the United States. China, a poor country, pollutes its rivers, lakes, and atmosphere in a way that is unimaginable in the United States.

Political Freedom and Social Justice Most people in the Western world value political freedoms such as those provided by the U.S. Constitution. And they value social justice—equality of opportunity and of access to social security safety nets that protect people from the extremes of misfortune.

A country might have a very large real GDP per person but have limited political freedom and social justice. For example, a small elite might enjoy political liberty and extreme wealth while the vast majority are effectively enslaved and live in abject poverty. Such an economy would generally be regarded as having a lower standard of living than one that had the same amount of real GDP but in which political freedoms were enjoyed by everyone. Today, China has rapid real GDP growth but limited political freedoms, while Poland and Ukraine have moderate real GDP growth but democratic political systems. Economists have no easy way to determine which of these countries is better off.

The Bottom Line Do we get the wrong message about the level and growth in economic well-being and the standard of living by looking at the growth of real GDP? The influences that are omitted from real GDP are probably important and could be large. Developing countries have a larger amount of household production and a larger underground economy than do developed countries so the gap between their living standards is exaggerated. Also, as real GDP grows, part of the measured growth might reflect a switch from home production to market production and underground to regular production. This measurement error overstates the growth in economic well-being and the improvement in the standard of living.

Economics in Action

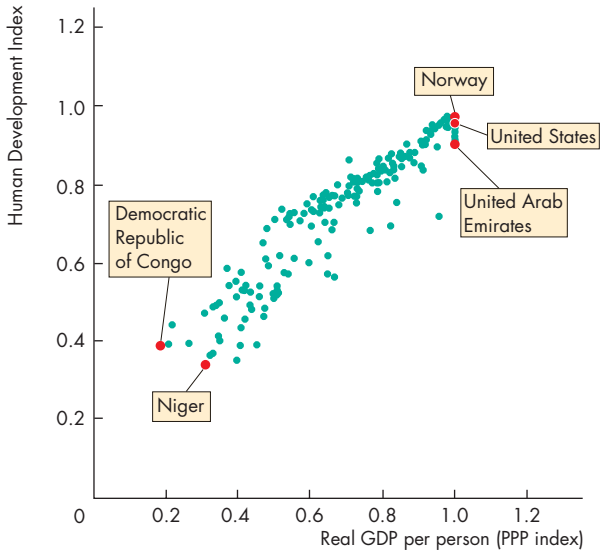
A Broader Indicator of Economic Well-Being

The limitations of real GDP reviewed in this chapter affect the standard of living and general well-being of every country. So to make international comparisons of the general state of economic well-being, we must look at real GDP and other indicators.

The United Nations has constructed a broader measure called the Human Development Index (HDI), which combines real GDP, life expectancy and health, and education. Real GDP per person (measured on the PPP basis) is a major component of the HDI.

The dots in the figure show the relationship between real GDP per person and the HDI. The United States (along with a few other countries) has the highest real GDP per person, but the United States has the thirteenth highest HDI. (Norway has the highest HDI, and Australia, Canada, and Japan have a higher HDI than the United States.)

The HDI of the United States is lower than that of 12 other countries because the people of those countries live longer and have better access to health care and education than do Americans.



The Human Development Index

Source of data: United nations hdr.undp.org/en/statistics/data

African nations have the lowest levels of economic well-being. The Democratic Republic of Congo has the lowest real GDP per person and Niger has the lowest HDI.

Other influences on the standard of living include the amount of leisure time available, the quality of the environment, the security of jobs and homes, and the safety of city streets.

It is possible to construct broader measures that combine the many influences that contribute to human happiness. Real GDP will be one element in those broader measures, but it will by no means be the whole of those measures. The United Nation's Human Development Index (HDI) is one example of attempts to provide broader measures of economic well-being and the standard of living. This measure places a good deal of weight on real GDP.

Dozens of other measures have been proposed. One includes resource depletion and emissions in a Green GDP measure. Another emphasizes the enjoyment of life rather than the production of goods in a "genuine progress index" or GPI.

Despite all the alternatives, real GDP per person remains the most widely used indicator of economic well-being.

REVIEW QUIZ

1. Distinguish between real GDP and potential GDP and describe how each grows over time.
2. How does the growth rate of real GDP contribute to an improved standard of living?
3. What is a business cycle and what are its phases and turning points?
4. What is PPP and how does it help us to make valid international comparisons of real GDP?
5. Explain why real GDP might be an unreliable indicator of the standard of living.

You can work these questions in Study Plan 4.3 and get instant feedback.

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You now know how economists measure GDP and what the GDP data tell us. *Reading Between the Lines* on pp. 96–97 uses GDP to describe some possible future paths as we emerge from recession.

Real GDP Forecasts in the Uncertain Economy of 2010

Shape of Recovery Long, Slow Growth … a "Square Root" Slog

http://www.denverpost.com
July 26, 2010

Hopes for a "V-shaped" recovery have shifted to fears of a "W-shaped" double dip.

William Greiner, president of Scout Investment Advisors, wants to add another symbol to the mix—the square root.

The square root represents a rebound, a smaller version of the V, followed by an extended period of below-average growth. No double dip, just a long, hard slog.

Greiner … predicts [a fall in] inflation-adjusted economic growth from 3.3 percent, the average in the post-war period, to about 2 percent, hence the square root.

No big deal? Think again.

"Potentially, the economic implications as to slow growth are monumental," Greiner said. "It is hard to overstate this issue."

Two percent real GDP growth will keep pace with U.S. population growth of 0.89 percent a year. But it won't leave much to form capital, fund research and development, and improve living standards.

Since World War II, the country has grown fast enough to double living standards every 29 years—translating into bigger homes, more cars and consumer goods, and more trips and meals out than previous generations enjoyed.

But at a 2 percent growth rate, living standards double every 64 years. Americans could be forced to shift their hopes for greater prosperity from their children to their grandchildren. …

What will make the slower growth feel even worse is that nominal economic growth, or GDP unadjusted for inflation, will run closer to 4 percent in the near term, far below its 7 percent average in recent decades. ...

The Denver Post and Aldo Svaldi, July 26, 2010.

ESSENCE OF THE STORY

- Investment advisor William Greiner says the recovery will be neither a V nor a W but the shape of the square root symbol.
- Greiner predicts real GDP growth of 2 percent a year, down from a 3.3 percent post-war average.
- A growth rate of 3.3 percent per year doubles the standard of living every 29 years, but at 2 percent a year the standard of living doubles every 64 years.
- The news article says that growth will feel even worse because nominal GDP will grow at only 4 percent a year, down from 7 percent a year in recent decades.

ECONOMIC ANALYSIS

- The 2008 recession was an unusually deep one and even by the middle of 2010, recovery was weak.
- Figure 1 illustrates the severity of the 2008 recession using the concepts of potential GDP and real GDP that you learned about in this chapter.
- At the *trough* in the second quarter of 2009, real GDP was almost $1 trillion below potential GDP.
- When real GDP is below potential GDP, the economy is operating *inside* the *PPF* (Chapter 2, pp. 30–31) and production is lost.
- To put the magnitude of the gap between potential GDP and real GDP into perspective, each person's share (*your* share) of the lost production in 2009 was about $3,250.
- The severity of the recession and the slow recovery led economists to speculate about the shape of the future recovery—about whether it will be V-shaped or W-shaped.
- A V-shaped recovery, illustrated in Fig. 2, would mean the resumption of rapid real GDP growth.
- A W-shaped recovery, also illustrated in Fig. 2, would be bad news. It means a "double-dip" recession. That is, there will be another downturn and recession before a recovery finally gets going.
- The news article speculates about a third shape—a "square-root" recovery. Figure 2 illustrates this possibility. A square root symbol has a flat top, which means zero real GDP growth. The real GDP path predicted in the news article is almost flat.
- The news article is correct to emphasize that a growth slowdown is a big deal. The Lucas wedge (p. 91) occurred because of a similar slowdown during the 1970s.
- But if real GDP growth does slow to 2 percent a year, the Lucas wedge will become extremely large.
- The news article is *not* correct that slow growth will feel even worse because nominal GDP will grow at only 4 percent a year, down from 7 percent a year in recent decades.
- The numbers are correct, but the reasoning is wrong. Growth will feel slow because (if the forecast is correct) it really will be slow.
- The point of calculating *real* GDP is to isolate the change in the quantity of goods and services produced—the real things on which the standard of living depends.
- A slowdown in *nominal* GDP growth combines the slowdown in real GDP growth and a slowdown in the inflation rate and obscures what is *really* happening to the standard of living.

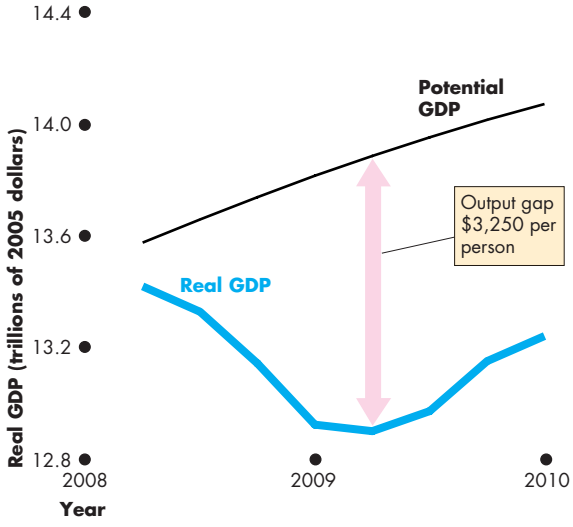

Figure 1 The deep 2008 recession

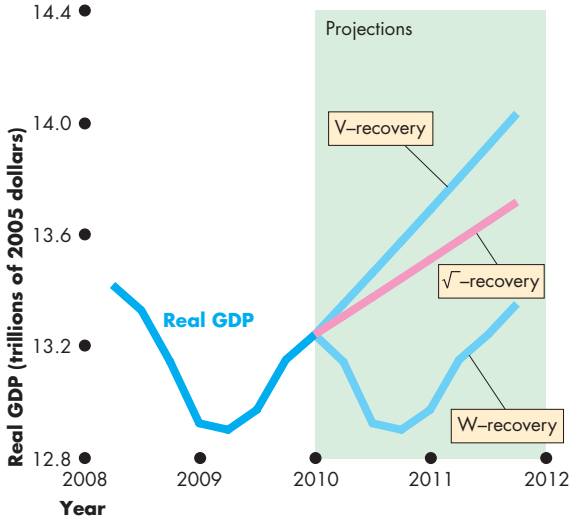

Figure 2 Some alternative recovery paths