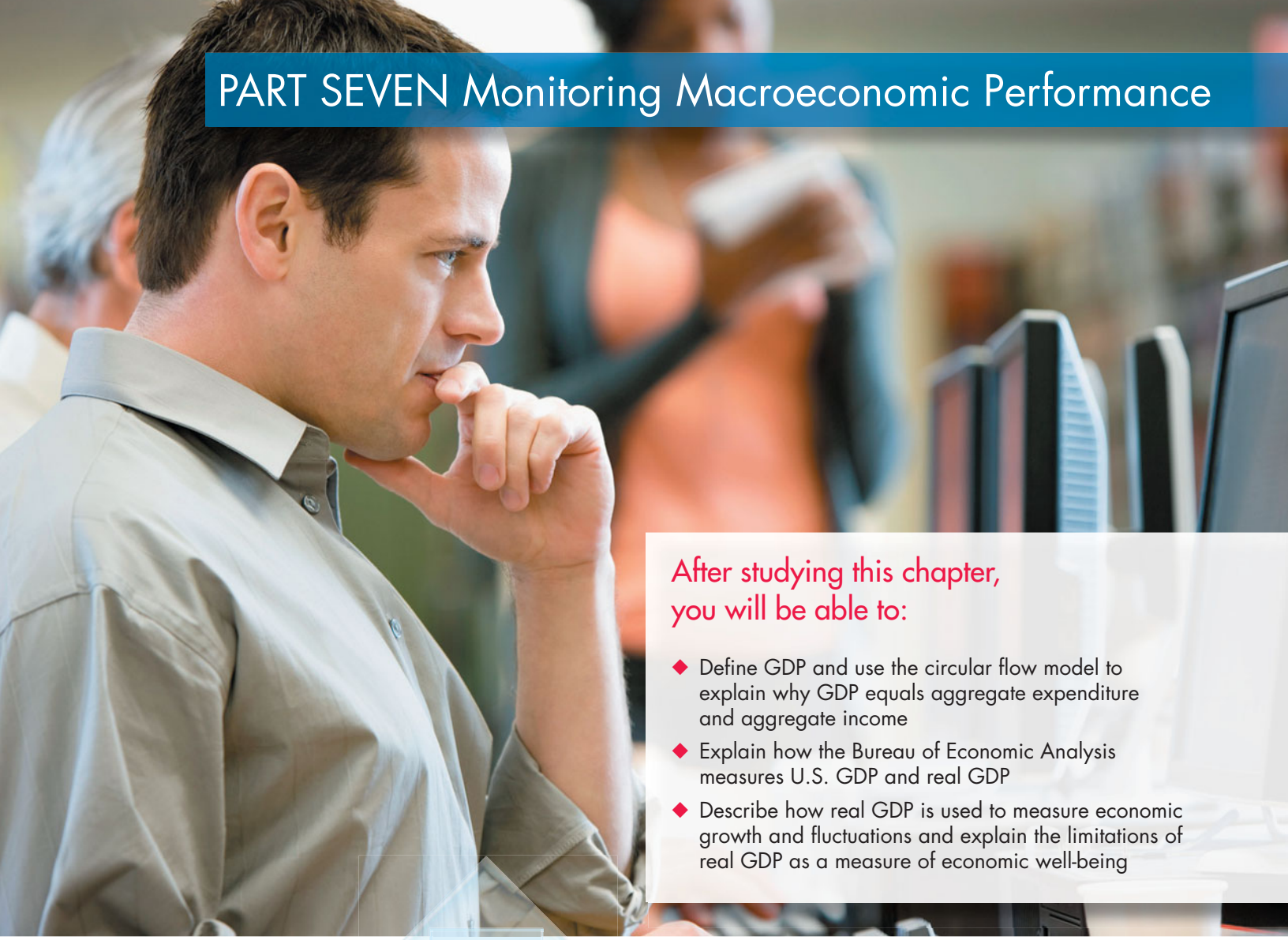


After studying this chapter, you will be able to:

- 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

21

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 21.1 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.

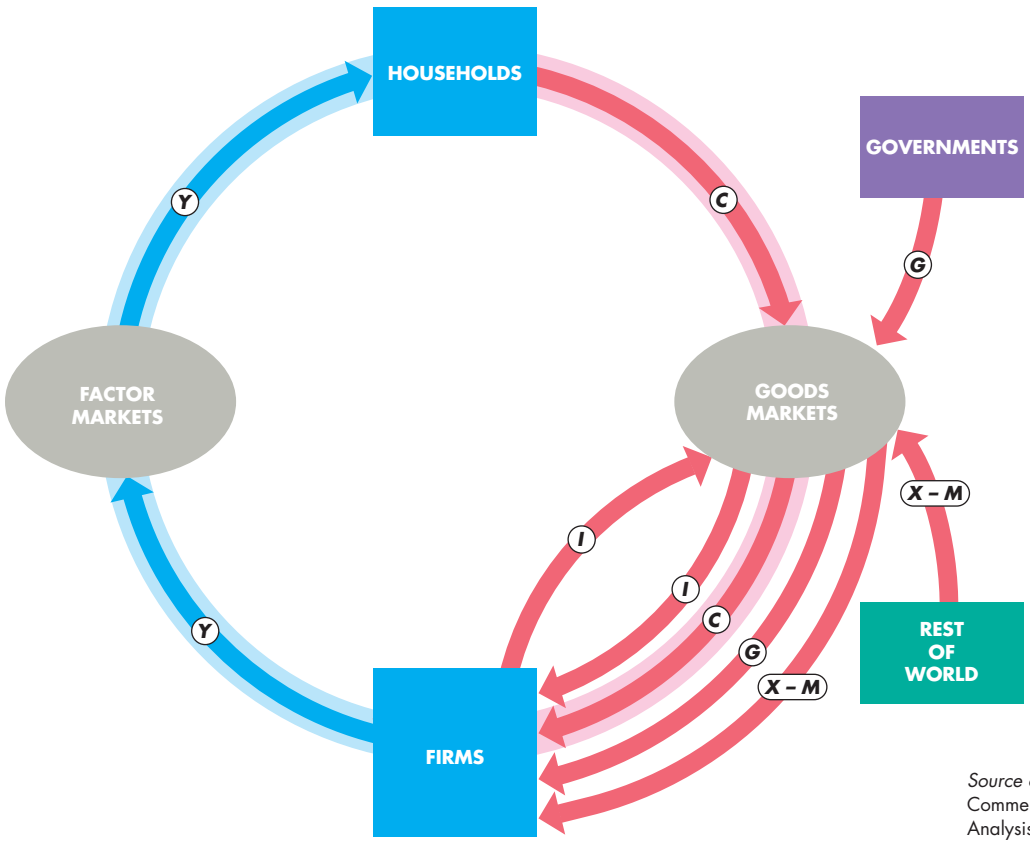
Households and Firms Households sell and firms buy the services of labor, capital, and land in factor markets. For these factor services, firms pay income to households: wages for labor services, interest for the use of capital, and rent for the use of land. A fourth factor of production, entrepreneurship, 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 21.1 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 21.1 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. 21.1, 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 21.1. 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. 21.1. 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. 21.1 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. 21.1 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 21.1 and get instant feedback. myeconlab

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. 21.1. Table 21.1 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 21.1 shows the relative magnitudes of the four items of aggregate expenditure.

TABLE 21.1 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. 21.1.

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 21.2 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 21.2 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. 506–507. 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 21.3 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 21.3(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 21.3(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 21.3 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 21.2 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.

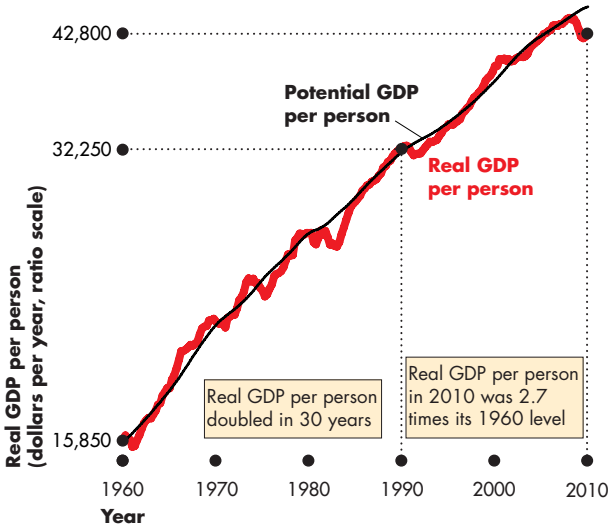
Figure 21.2 shows the path of U.S. real GDP per person for the 50 years from 1960 to 2010 and highlights two features of our expanding living standard:

- 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. 21.2, 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 21.2 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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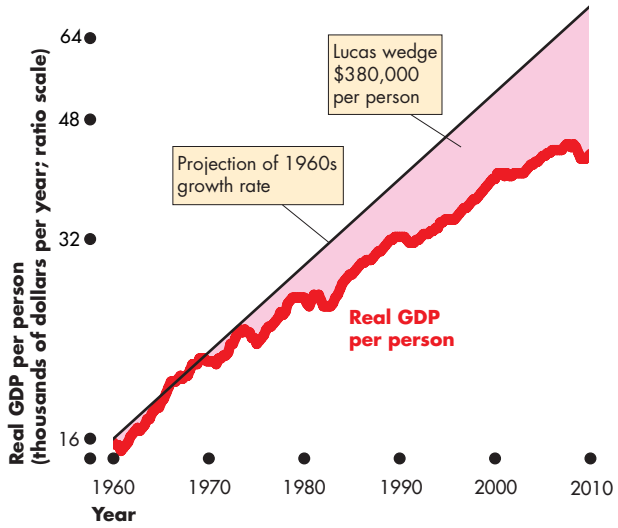
Fluctuations of Real GDP You can see that real GDP shown by the red line in Fig. 21.2 fluctuates around potential GDP, and sometimes real GDP shrinks.

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 21.3 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 21.3 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 21.4 shows these features of the most recent U.S. business cycle.

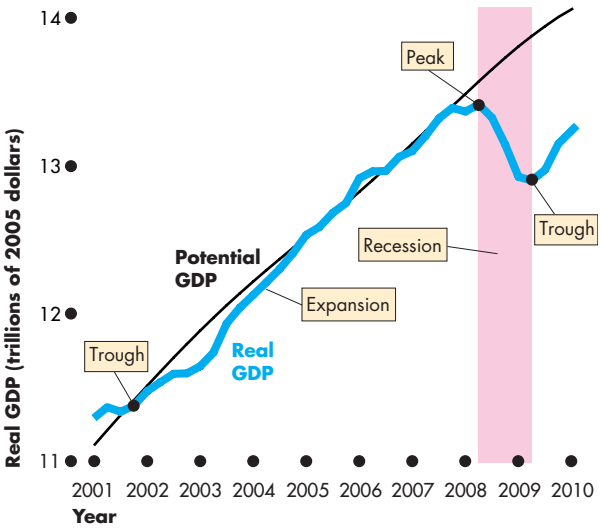
An **expansion** is a period during which real GDP increases. In the early stage of an expansion real GDP returns to potential GDP and as the expansion progresses, potential GDP grows and real GDP eventually exceeds potential GDP.

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. 502–503).

FIGURE 21.4 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

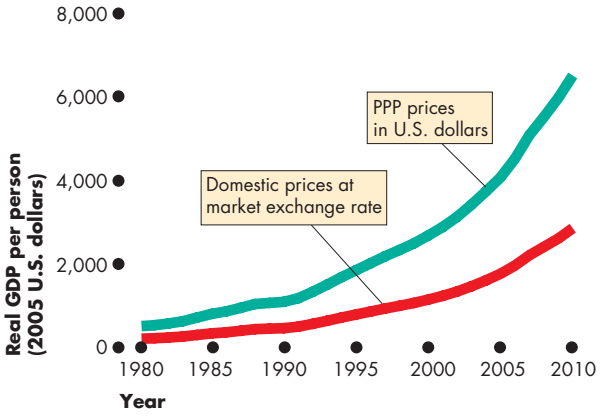
Two problems arise in using real GDP to compare living standards across countries. First, the real GDP of one country must be converted into the same currency units as the real GDP of the other country. Second, the goods and services in both countries must be valued at the same prices. Comparing the 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. 21.5 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 21.5 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 21.5 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

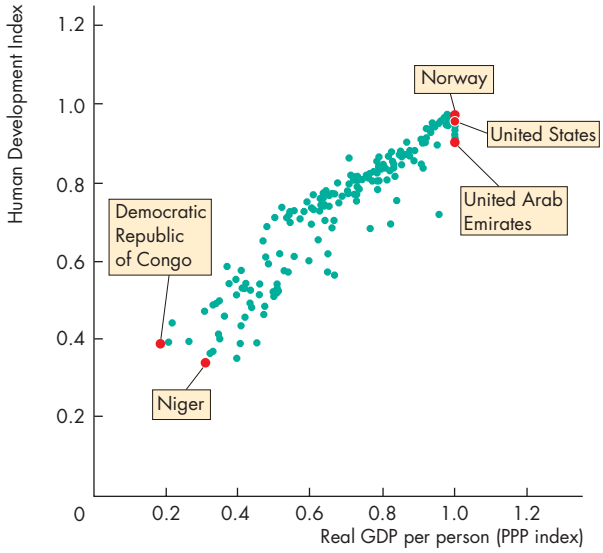
A Broader Indicator of Economic Well-Being

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 21.3 and get instant feedback. myeconlab

You now know how economists measure GDP and what the GDP data tell us. *Reading Between the Lines* on pp. 502–503 uses GDP to describe some possible future paths as we emerge from recession.

Real GDP Forecasts in the Uncertain Economy of 2010

(This item omitted from WebBook edition)

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. 497) 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.

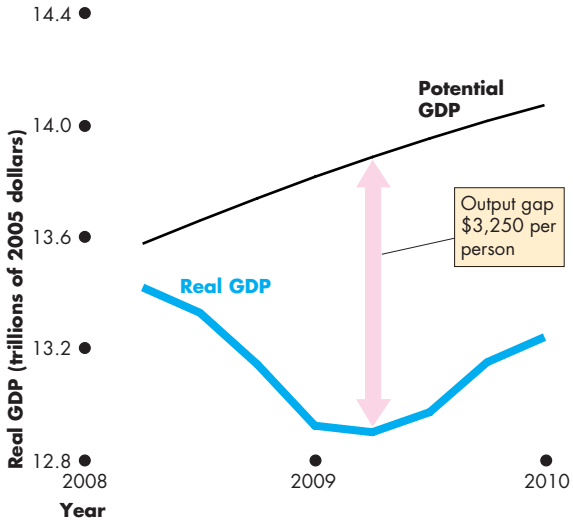


Figure 1 The deep 2008 recession

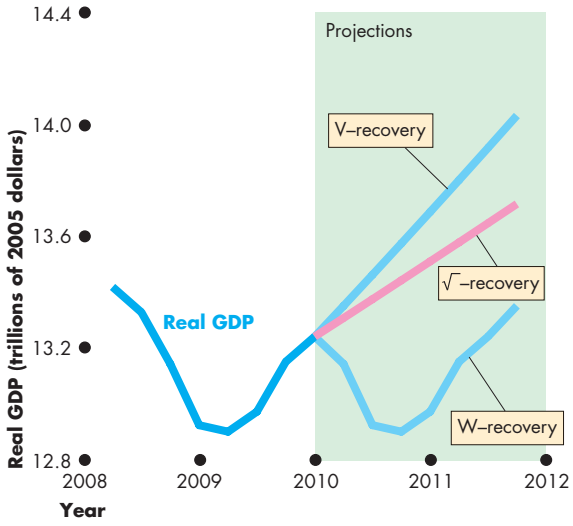


Figure 2 Some alternative recovery paths

APPENDIX

Graphs in Macroeconomics

After studying this appendix, you will be able to:

- Make and interpret a time-series graph
- Make and interpret a graph that uses a ratio scale

The Time-Series Graph

In macroeconomics we study the fluctuations and trends in the key variables that describe macroeconomic performance and policy. These variables include GDP and its expenditure and income components that you've learned about in this chapter. They also include variables that describe the labor market and consumer prices that you study in Chapter 22.

Regardless of the variable of interest, we want to be able to compare its value today with that in the past; and we want to describe how the variable has changed over time. The most effective way to do these things is to make a time-series graph.

Making a Time-Series Graph

A **time-series graph** measures time (for example, years, quarters, or months) on the *x*-axis and the variable or variables in which we are interested on the *y*-axis. Figure A21.1 is an example of a time-series graph. It provides some information about unemployment in the United States since 1980. In this figure, we measure time in years starting in 1980. We measure the unemployment rate (the variable that we are interested in) on the *y*-axis.

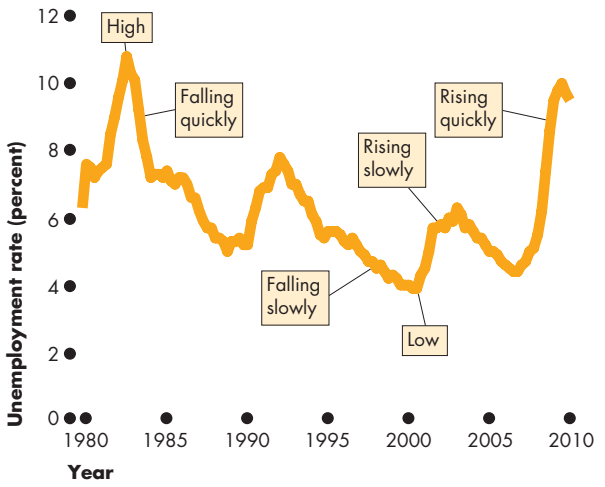
A time-series graph enables us to visualize how a variable has changed over time and how its value in one period relates to its value in another period. It conveys an enormous amount of information quickly and easily.

Let's see how to "read" a time-series graph.

Reading a Time-Series Graph

To practice reading a time-series graph, take a close look at Fig. A21.1. The graph shows the level, change and speed of change of the variable.

FIGURE A21.1 A Time-Series Graph



A time-series graph plots the level of a variable on the *y*-axis against time (here measured in years) on the *x*-axis. This graph shows the unemployment rate each year from 1980 to 2010. Its shows when unemployment was high, when it was low, when it increased, when it decreased and when it changed quickly and slowly.

myeconlab animation

- The *level* of the variable: It tells us when unemployment is *high* and *low*. When the line is a long distance above the *x*-axis, the unemployment rate is high, as it was, for example, in 1983 and again in 2009. When the line is close to the *x*-axis, the unemployment rate is low, as it was, for example, in 2001.
- The *change* in the variable: It tells us how unemployment *changes*—whether it *increases* or *decreases*. When the line slopes upward, as it did in 2008 and 2009, the unemployment rate is rising. When the line slopes downward, as it did in 1984 and 1997, the unemployment rate is falling.
- The *speed of change* in the variable: It tells us whether the unemployment rate is rising or falling *quickly* or *slowly*. If the line is very steep, then the unemployment rate increases or decreases quickly. If the line is not steep, the unemployment rate increases or decreases slowly. For example, the unemployment rate rose quickly in 2008 and slowly in 2003 and it fell quickly in 1984 and slowly in 1997.

Ratio Scale Reveals Trend

A time-series graph also reveals whether a variable has a **cycle**, which is a tendency for a variable to alternate between upward and downward movements, or a **trend**, which is a tendency for a variable to move in one general direction.

The unemployment rate in Fig. A21.1 has a cycle but no trend. When a trend is present, a special kind of time-series graph, one that uses a ratio scale on the *y*-axis, reveals the trend.

A Time-Series with a Trend

Many macroeconomics variables, among them GDP and the average level of prices, have an upward trend. Figure A21.2 shows an example of such a variable: the average prices paid by consumers.

In Fig. A21.2(a), consumer prices since 1970 are graphed on a normal scale. In 1970 the level is 100. In other years, the average level of prices is measured as a percentage of the 1970 level.

The graph clearly shows the upward trend of prices. But it doesn't tell us when prices were rising fastest or whether there was any change in the trend. Just looking at the upward-sloping line in Fig. A21.2(a) gives the impression that the pace of growth of consumer prices was constant.

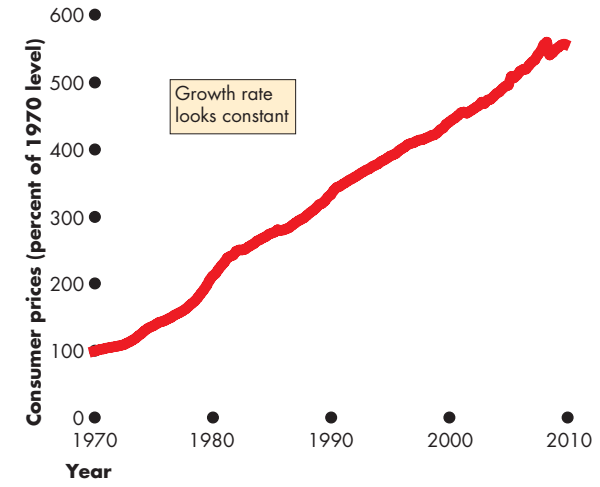
Using a Ratio Scale

On a graph axis with a normal scale, the gap between 1 and 2 is the same as that between 3 and 4. On a graph axis with a ratio scale, the gap between 1 and 2 is the same as that between 2 and 4. The ratio 2 to 1 equals the ratio 4 to 2. By using a ratio scale, we can "see" when the growth rate (the percentage change per unit of time) changes.

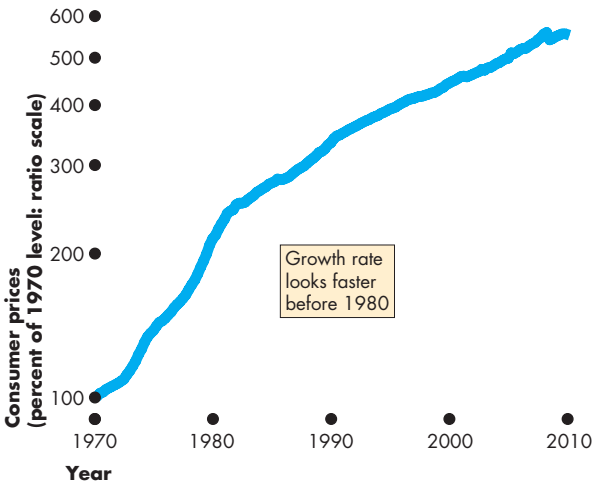
Figure A21.2(b) shows an example of a ratio scale. Notice that the values on the *y*-axis get closer together but the gap between 400 and 200 equals the gap between 200 and 100: The ratio gaps are equal.

Graphing the data on a ratio scale reveals the trends. In the case of consumer prices, the trend is much steeper during the 1970s and early 1980s than in the later years. The steeper the line in the ratio-scale graph in part (b), the faster are prices rising. Prices rose rapidly during the 1970s and early 1980s and more slowly in the later 1980s and 1990s. The ratio-scale graph reveals this fact. We use ratio-scale graphs extensively in macroeconomics.

FIGURE A21.2 Ratio Scale Reveals Trend



(a) Normal scale



(b) Ratio scale

The graph shows the average of consumer prices from 1970 to 2010. The level is 100 in 1970 and the value for other years are percentages of the 1970 level. Consumer prices normally rise each year so the line slopes upward. In part (a), where the *y*-axis scale is normal, the rate of increase appears to be constant.

In part (b), where the y-axis is a ratio scale (the ratio of 400 to 200 equals the ratio 200 to 100), prices rose faster in the 1970s and early 1980s and slower in the later years. The ratio scale reveals this trend.

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MATHEMATICAL NOTE
Chained-Dollar Real GDP

In the real GDP calculation on p. 495, real GDP in 2010 is 1.6 times its value in 2005. But suppose that we use 2010 as the reference base year and value real GDP in 2005 at 2010 prices. If you do the math, you will see that real GDP in 2005 is $150 million at 2010 prices. GDP in 2010 is $300 million (in 2010 prices), so now the numbers say that real GDP has doubled. Which is correct: Did real GDP increase 1.6 times or double? Should we use the prices of 2005 or 2010? The answer is that we need to use *both* sets of prices.

The Bureau of Economic Analysis uses a measure of real GDP called **chained-dollar real GDP**. Three steps are needed to calculate this measure:

- Value production in the prices of adjacent years
- Find the average of two percentage changes
- Link (chain) back to the reference base year

Value Production in Prices of Adjacent Years

The first step is to value production in *adjacent* years at the prices of *both* years. We'll make these calculations for 2010 and its preceding year, 2009.

Table 1 shows the quantities produced and prices in the two years. Part (a) shows the nominal GDP calculation for 2009—the quantities produced in 2009 valued at the prices of 2009. Nominal GDP in 2009 is $145 million. Part (b) shows the nominal GDP calculation for 2010—the quantities produced in 2010 valued at the prices of 2010. Nominal GDP in 2010 is $300 million. Part (c) shows the value of the quantities produced in 2010 at the prices of 2009. This total is $160 million. Finally, part (d) shows the value of the quantities produced in 2009 at the prices of 2010. This total is $275 million.

TABLE 1 Real GDP Calculation Step 1: Value Production in Adjacent Years at Prices of Both Years

	Item	Quantity (millions)	Price (dollars)	Expenditure (millions of dollars)
(a) In 2009				
C	T-shirts	3	5	15
I	Computer chips	3	10	30
G	Security services	5	20	100
Y	Real and Nominal GDP in 2009			**145**
(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 2009				
C	T-shirts	4	5	20
I	Computer chips	2	10	20
G	Security services	6	20	120
Y	2010 production at 2009 prices			**160**
(d) Quantities of 2009 valued at prices of 2010				
C	T-shirts	3	5	15
I	Computer chips	3	20	60
G	Security services	5	40	200
Y	2009 production at 2010 prices			**275**

Step 1 is to value the production of adjacent years at the prices of both years. Here, we value the production of 2009 and 2010 at the prices of both 2009 and 2010. The value of 2009 production at 2009 prices, in part (a), is nominal GDP in 2009. The value of 2010 production at 2010 prices, in part (b), is nominal GDP in 2010. Part (c) calculates the value of 2010 production at 2009 prices, and part (d) calculates the value of 2009 production at 2010 prices. We use these numbers in Step 2.

Find the Average of Two Percentage Changes

The second step is to find the percentage change in the value of production based on the prices in the two adjacent years. Table 2 summarizes these calculations.

Part (a) shows that, valued at the prices of 2009, production increased from $145 million in 2009 to $160 million in 2010, an increase of 10.3 percent.

Part (b) shows that, valued at the prices of 2010, production increased from $275 million in 2009 to $300 million in 2010, an increase of 9.1 percent. Part (c) shows that the average of these two percentage changes in the value of production is 9.7. That is, $(10.3 + 9.1) \div 2 = 9.7$.

By applying this average percentage change to real GDP, we can find the value of real GDP in 2010. Real GDP in 2009 is $145 million, so a 9.7 percent increase is $14 million. Then real GDP in 2010 is

TABLE 2 Real GDP Calculation Step 2: Find Average of Two Percentage Changes

Value of Production	Millions of dollars	
(a) At 2009 prices		
Nominal GDP in 2009	145	
2010 production at 2009 prices	160	
Percentage change in production at 2009 prices		10.3
(b) At 2010 prices		
2009 production at 2010 prices	275	
Nominal GDP in 2010	300	
Percentage change in production at 2010 prices		9.1
(c) Average percentage change in 2010		**9.7**

Using the numbers calculated in Step 1, the percentage change in production from 2009 to 2010 valued at 2009 prices is 10.3 percent, in part (a). The percentage change in production from 2009 to 2010 valued at 2010 prices is 9.1 percent, in part (b). The average of these two percentage changes is 9.7 percent, in part (c).

$145 million plus $14 million, which equals $159 million. Because real GDP in 2009 is in 2009 dollars, real GDP in 2010 is also in 2009 dollars.

Although the real GDP of $159 million is expressed in 2009 dollars, the calculation uses the average of the prices of the final goods and services that make up GDP in 2009 and 2010.

Link (Chain) to the Base Year

The third step is to express GDP in the prices of the reference base year. To do this, the BEA performs calculations like the ones that you've just worked through to find the percentage change in real GDP in *each* pair of years. It then selects a base year (currently 2005) in which, by definition, real GDP equals nominal GDP. Finally, it uses the percentage changes to calculate real GDP in 2005 prices starting from real GDP in 2005.

To illustrate this third step, we'll assume that the BEA has calculated the growth rates since 2004 shown in Table 3. The 2010 growth rate that we've just calculated is highlighted in the table. The other (assumed) growth rates are calculated in exactly the same way as that for 2010.

TABLE 3 Real GDP Calculation Step 3: Repeat Growth Rate Calculations

Year	2005	2006	2007	2008	2009	**2010**
Growth rate	7.0	8.0	6.0	7.0	8.0	**9.7**

Figure 1 illustrates the chain link calculations. In the reference base year, 2005, real GDP equals nominal GDP, which we'll assume is $125 million. Table 3 tells us that the growth rate in 2005 was 7 percent, so real GDP in 2005 is 7 percent higher than it was in 2004, which means that real GDP in 2004 is $117 million (117 × 1.07 = 125).

Table 3 also tells us that the growth rate in 2006 was 8 percent, so real GDP in 2006 is 8 percent higher than it was in 2005, which means that real GDP in 2006 is $135 million (125 × 1.08 = 135).

By repeating these calculations for each year, we obtain *chained-dollar real GDP* in 2005 dollars for each year. In 2009, *chained-dollar real GDP* in 2005 dollars is $165 million. So the 9.7 percent growth rate in 2010 that we calculated in Table 2 means that real GDP in 2010 is $181 million.

Notice that the growth rates are independent of the reference base year, so changing the reference base year does not change the growth rates.

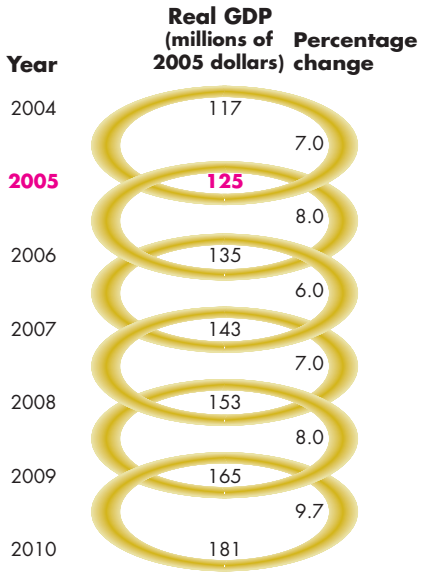

Figure 1 Real GDP calculation step 3: link (chain) back to base year

SUMMARY

Key Points

Gross Domestic Product (pp. 490–492)

- GDP, or gross domestic product, is the market value of all the final goods and services produced in a country during a given period.
- A final good is an item that is bought by its final user, and it contrasts with an intermediate good, which is a component of a final good.
- GDP is calculated by using either the expenditure or income totals in the circular flow model.
- Aggregate expenditure on goods and services equals aggregate income and GDP.

Working Problems 1 to 7 will give you a better understanding of gross domestic product.

Measuring U.S. GDP (pp. 493–495)

- Because aggregate expenditure, aggregate income, and the value of aggregate production are equal, we can measure GDP by using the expenditure approach or the income approach.
- The expenditure approach sums consumption expenditure, investment, government expenditure on goods and services, and net exports.
- The income approach sums wages, interest, rent, and profit (plus indirect taxes less subsidies plus depreciation).
- Real GDP is measured using a common set of prices to remove the effects of inflation from GDP.

Working Problems 8 to 15 will give you a better understanding of measuring U.S. GDP.

The Uses and Limitations of Real GDP

(pp. 496–501)

- Real GDP is used to compare the standard of living over time and across countries.
- Real GDP per person grows and fluctuates around the more smoothly growing potential GDP.
- A slowing of the growth rate of real GDP per person during the 1970s has lowered incomes by a large amount.
- International real GDP comparisons use PPP prices.
- Real GDP is not a perfect measure of the standard of living because it excludes household production, the underground economy, health and life expectancy, leisure time, environmental quality, and political freedom and social justice.

Working Problem 16 will give you a better understanding of the uses and limitations of real GDP.

Key Terms

Business cycle, 497
Chained-dollar real GDP, 506
Consumption expenditure, 491
Cycle, 505
Depreciation, 492
Expansion, 497
Exports, 492
Final good, 490
Government expenditure, 492
Gross domestic product (GDP), 490
Gross investment, 492
Imports, 492
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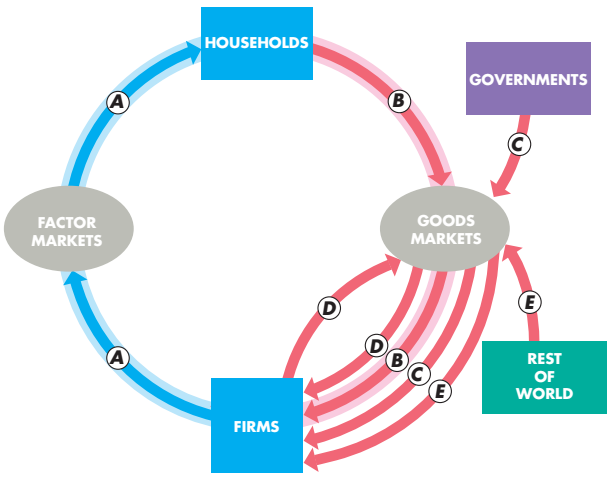
STUDY PLAN PROBLEMS AND APPLICATIONS

myeconlab You can work Problems 1 to 17 in MyEconLab Chapter 21 Study Plan and get instant feedback.

Gross Domestic Product (Study Plan 21.1)

1. Classify each of the following items as a final good or service or an intermediate good or service and identify which is a component of consumption expenditure, investment, or government expenditure on goods and services:
   - Banking services bought by a student.
   - New cars bought by Hertz, the car rental firm.
   - Newsprint bought by *USA Today* .
   - The purchase of a new limo for the president.
   - New house bought by Al Gore.
2. The firm that printed this textbook bought the paper from XYZ Paper Mills. Was this purchase of paper part of GDP? If not, how does the value of the paper get counted in GDP?

Use the following figure, which illustrates the circular flow model, to work Problems 3 and 4.



3. During 2008, in an economy:
   - Flow *B* was $9 trillion.
   - Flow *C* was $2 trillion.
   - Flow *D* was $3 trillion.
   - Flow *E* was –$0.7 trillion.

   Name the flows and calculate the value of
   a. Aggregate income.
   b. GDP.
4. During 2009, flow *A* was $13.0 trillion, flow *B* was $9.1 trillion, flow *D* was $3.3 trillion, and flow *E* was –$0.8 trillion.

   Calculate the 2009 values of
   a. GDP.
   b. Government expenditure.
5. Use the following data to calculate aggregate expenditure and imports of goods and services.
   - Government expenditure: $20 billion
   - Aggregate income: $100 billion
   - Consumption expenditure: $67 billion
   - Investment: $21 billion
   - Exports of goods and services: $30 billion
6. **U.S. Economy Shrinks Modestly**

   GDP fell 1 percent as businesses cut investment by 8.9 percent, consumers cut spending by 1.2 percent, purchases of new houses fell 38 percent, and exports fell 29.9 percent.

   Source: Reuters, July 31, 2009

   Use the letters on the figure in Problem 3 to indicate the flow in which each item in the news clip occurs. How can GDP have fallen by only 1.0 percent with the big expenditure cuts reported?
7. A U.S. market research firm deconstructed an Apple iPod and studied the manufacturers, costs, and profits of each of the parts and components. The final results are
   - An Apple iPod sells in the United States for $299.
   - A Japanese firm, Toshiba, makes the hard disk and display screen, which cost $93.
   - Other components produced in South Korea cost $25.
   - Other components produced in the United States cost $21.
   - The iPod is assembled in China at a cost of $5.
   - The costs and profits of retailers, advertisers, and transportation firms in the United States are $75.

   a. What is Apple's profit?
   b. Where in the national income and product accounts of the United States, Japan, South Korea, and China are these transactions recorded.
   c. What contribution does one iPod make to world GDP?

Measuring U.S. GDP (Study Plan 21.2)

Use the following data to work Problems 8 and 9.

The table lists some macroeconomic data for the United States in 2008.

Item	Billions of dollars
Wages paid to labor	8,000
Consumption expenditure	10,000
Net operating surplus	3,200
Investment	2,000
Government expenditure	2,800
Net exports	–700
Depreciation	1,800

8. Calculate U.S. GDP in 2008.
9. Explain the approach (expenditure or income) that you used to calculate GDP.

Use the following data to work Problems 10 and 11.

The national accounts of Parchment Paradise are kept on (you guessed it) parchment. A fire destroys the statistics office. The accounts are now incomplete but they contain the following data:

- GDP (income approach): $2,900
- Consumption expenditure: $2,000
- Indirect taxes less subsidies: $100
- Net operating surplus: $500
- Investment: $800
- Government expenditure: $400
- Wages: $2,000
- Net exports: –$200

10. Calculate GDP (expenditure approach) and depreciation.
11. Calculate net domestic income at factor cost and the statistical discrepancy.

Use the following data to work Problems 12 and 13.

Tropical Republic produces only bananas and coconuts. The base year is 2008, and the table gives the quantities produced and the prices.

Quantities	2008	2009
Bananas	800 bunches	900 bunches
Coconuts	400 bunches	500 bunches
Prices	**2008**	**2009**
Bananas	$2 a bunch	$4 a bunch
Coconuts	$10 a bunch	$5 a bunch

12. Calculate nominal GDP in 2008 and 2009.
13. Calculate real GDP in 2009 expressed in base-year prices.

Use the following news clip to work Problems 14 and 15.

Toyota to Shift U.S. Manufacturing Efforts

Toyota announced it planned to adjust its U.S. manufacturing operations to meet customer demands for smaller, more fuel-efficient vehicles. In 2008, Toyota started building a plant to produce the 2010 Prius for the U.S. market in Blue Springs, Mississippi. Earlier models of the Prius were produced in Asia.

Source: CNN, July 10, 2008

14. Explain how this change by Toyota will influence U.S. GDP and the components of aggregate expenditure.
15. Explain how this change by Toyota will influence the factor incomes that make up U.S. GDP.

The Uses and Limitations of Real GDP (Study Plan 21.3)

16. Use the following table to work out in which year the U.S. standard of living (i) increases and (ii) decreases? Explain your answer.

Year	Real GDP	Population
2006	$13.0 trillion	300 million
2007	$13.2 trillion	302 million
2008	$13.2 trillion	304 million
2009	$12.8 trillion	307 million

Mathematical Note (Study Plan 21.MN)

17. The table provides data on the economy of Maritime Republic that produces only fish and crabs.

Quantities	2009	2010
Fish	1,000 tons	1,100 tons
Crabs	500 tons	525 tons
Prices	**2009**	**2010**
Fish	$20 a ton	$30 a ton
Crabs	$10 a ton	$8 a ton

a. Calculate Maritime Republic's nominal GDP in 2009 and 2010.

b. Calculate Maritime Republic's chained-dollar real GDP in 2010 expressed in 2009 dollars.

Data Graphing

Use the *Data Grapher* in MyEconLab to work Problems 18 and 19.

18. In which country in 2009 was the growth rate of real GDP per person highest: Canada, Japan, or the United States?
19. In which country in 2009 was the growth rate of real GDP per person lowest: France, China, or the United States?

ADDITIONAL PROBLEMS AND APPLICATIONS

myeconlab You can work these problems in MyEconLab if assigned by your instructor.

Gross Domestic Product

20. Classify each of the following items as a final good or service or an intermediate good or service and identify which is a component of consumption expenditure, investment, or government expenditure on goods and services:
    - Banking services bought by Google.
    - Security system bought by the New York Stock Exchange.
    - Coffee beans bought by Starbucks.
    - New coffee grinders bought by Starbucks.
    - Starbuck's grande mocha frappuccino bought by a student.
    - New battle ship bought by the U.S. Navy.

Use the figure in Problem 3 to work Problems 21 and 22.

21. In 2009, flow *A* was $1,000 billion, flow *C* was $250 billion, flow *B* was $650 billion, and flow *E* was $50 billion. Calculate investment.
22. In 2010, flow *D* was $2 trillion, flow *E* was –$1 trillion, flow *A* was $10 trillion, and flow *C* was $4 trillion. Calculate consumption expenditure.

Use the following information to work Problems 23 and 24.

Mitsubishi Heavy Industries makes the wings of the new Boeing 787 Dreamliner in Japan. Toyota assembles cars for the U.S. market in Kentucky.

23. Explain where these activities appear in the U.S. National Income and Product Accounts.
24. Explain where these activities appear in Japan's National Income and Product Accounts.

Use the following news clip to work Problems 25 and 26, and use the circular flow model to illustrate your answers.

Boeing Bets the House

Boeing is producing some components of its new 787 Dreamliner in Japan and is assembling it in the United States. Much of the first year's production will be sold to ANA (All Nippon Airways), a Japanese airline.

Source: *The New York Times*, May 7, 2006

25. Explain how Boeing's activities and its transactions affect U.S. and Japanese GDP.
26. Explain how ANA's activities and its transactions affect U.S. and Japanese GDP.

Measuring U.S. GDP

Use the following data to work Problems 27 and 28.

The table lists some macroeconomic data for the United States in 2009.

Item	Billions of dollars
Wages paid to labor	8,000
Consumption expenditure	10,000
Net operating surplus	3,400
Investment	1,500
Government expenditure	2,900
Net exports	–340

27. Calculate U.S. GDP in 2009.
28. Explain the approach (expenditure or income) that you used to calculate GDP.

Use the following data to work Problems 29 to 31.

An economy produces only apples and oranges. The base year is 2009, and the table gives the quantities produced and the prices.

Quantities	2009	2010
Apples	60	160
Oranges	80	220
Prices	**2009**	**2010**
Apples	$0.50	$1.00
Oranges	$0.25	$2.00

29. Calculate nominal GDP in 2009 and 2010.
30. Calculate real GDP in 2009 and 2010 expressed in base-year prices.
31. **GDP Expands 11.4 Percent, Fastest in 13 Years**

    China's gross domestic product grew 11.4 percent last year and marked a fifth year of double-digit growth. The increase was especially remarkable given that the United States is experiencing a slowdown due to the sub-prime crisis and housing slump. Citigroup estimates that each 1 percent drop in the U.S. economy will shave 1.3 percent off China's growth, because Americans are heavy users of Chinese products. In spite of the uncertainties, China is expected to post its sixth year of double-digit growth next year.

    Source: *The China Daily*, January 24, 2008

    Use the expenditure approach for calculating China's GDP to explain why "each 1 percent drop in the U.S. economy will shave 1.3 percent off China's growth."

The Uses and Limitations of Real GDP

32. The United Nations' Human Development Index (HDI) is based on real GDP per person, life expectancy at birth, and indicators of the quality and quantity of education.
    a. Explain why the HDI might be better than real GDP as a measure of economic welfare.
    b. Which items in the HDI are part of real GDP and which items are not in real GDP?
    c. Do you think the HDI should be expanded to include items such as pollution, resource depletion, and political freedom? Explain.
    d. What other influences on economic welfare should be included in a comprehensive measure?
33. **U.K. Living Standards Outstrip U.S.**

    Oxford analysts report that living standards in Britain are set to rise above those in America for the first time since the nineteenth century. Real GDP per person in Britain will be £23,500 this year, compared with £23,250 in America, reflecting not only the strength of the pound against the dollar but also the UK economy's record run of growth since 2001. But the Oxford analysts also point out that Americans benefit from lower prices than those in Britain.

    Source: *The Sunday Times*, January 6, 2008

    If real GDP per person is more in the United Kingdom than in the United States but Americans benefit from lower prices, does this comparison of real GDP per person really tell us which country has the higher standard of living?
34. Use the news clip in Problem 31.
    a. Why might China's recent GDP growth rates overstate the actual increase in the level of production taking place in China?
    b. Explain the complications involved with attempting to compare the economic welfare in China and the United States by using the GDP for each country.
35. **Poor India Makes Millionaires at Fastest Pace**

    India, with the world's largest population of poor people created millionaires at the fastest pace in the world in 2007. India added another 23,000 more millionaires in 2007 to its 2006 tally of 100,000 millionaires measured in dollars. That is 1 millionaire for about 7,000 people living on less than $2 a day.

    Source: *The Times of India*, June 25, 2008
    a. Why might real GDP per person misrepresent the standard of living of the average Indian?
    b. Why might $2 a day underestimate the standard of living of the poorest Indians?

Economics in the News

36. After you have studied *Reading Between the Lines* on pp. 502–503 answer the following questions.
    a. Which measure of GDP would you use to describe the shape of the recovery from recession: real GDP or nominal GDP? Explain your answer.
    b. Which measure of GDP would you use to describe the rate of growth of the standard of living: real GDP or nominal GDP? Explain your answer.
    c. If the recovery was a precise "square-root" shape, what would the growth rate of real GDP be?
    d. Why is the news article wrong about the effect of a slowdown in nominal GDP growth on how slow the growth rate will "feel"?
37. **Totally Gross**

    GDP has proved useful in tracking both short-term fluctuations and long-run growth. Which isn't to say GDP doesn't miss some things. Amartya Sen, at Harvard, helped create the United Nations' Human Development Index, which combines health and education data with per capita GDP to give a better measure of the wealth of nations. Joseph Stiglitz, at Columbia, advocates a "green net national product" that takes into account the depletion of natural resources. Others want to include happiness in the measure. These alternative benchmarks have merit but can they be measured with anything like the frequency, reliability and impartiality of GDP?

    Source: *Time*, April 21, 2008
    a. Explain the factors that the news clip identifies as limiting the usefulness of GDP as a measure of economic welfare.
    b. What are the challenges involved in trying to incorporate measurements of those factors in an effort to better measure economic welfare?
    c. What does the ranking of the United States in the Human Development Index imply about the levels of health and education relative to other nations?

Mathematical Note

38. Use the information in Problem 29 to calculate the chained-dollar real GDP in 2010 expressed in 2009 dollars.