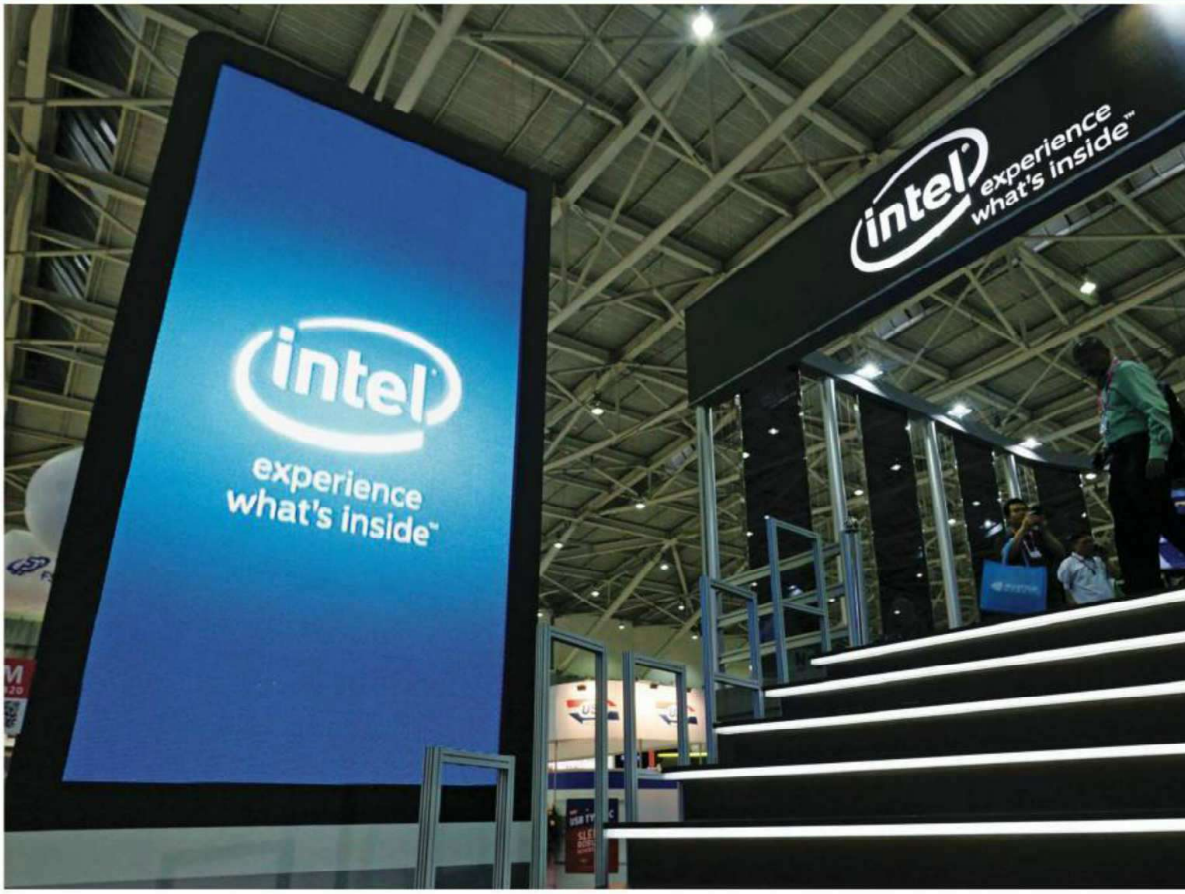
CHAPTER
12

Aggregate Expenditure and Output in the Short Run

Chapter Outline and Learning Objectives



Fluctuating Demand Helps—and Hurts—Intel and Other Firms

Robert Noyce and Gordon Moore founded Intel in 1968. Today, the company is the world's largest semiconductor manufacturer and a major supplier of the microprocessors and memory chips that power desktop and laptop computers sold by Dell, Apple, Lenovo, Hewlett-Packard, and other computer manufacturers.

To this point, Intel's success has depended on the health of the computer market. As a result, the firm faces two problems: First, in the past few years, sales of computers have declined because many consumers and some businesses have switched to using tablets and smartphones to access the Internet. Second, Intel is vulnerable to the swings of the business cycle because sales of computers rise during economic expansions and fall during recessions. Intel was particularly hurt by the 2007–2009 recession. During the last quarter of 2008, Intel's revenues fell 90 percent, and the firm laid off 6,000 workers. Conditions improved for the firm beginning in 2010, as the U.S. economy recovered from the recession, although the firm was still struggling to reduce its dependence on selling chips to computer manufacturers. In 2015, Intel decided to lay off several hundred employees because businesses were only slowly increasing spending on computers and other information processing equipment.

The recovery from the 2007–2009 recession was by some measures the weakest since the end of World War II in 1945. By 2015, though, some industries were prospering. For example, sales of automobiles reached pre-recession levels. However, other industries still struggled. A weak recovery in spending by businesses on factories, office buildings, and other structures was bad news for some firms, including steelmakers. Worthington Industries, an Ohio-based steelmaker, announced that it would lay off 555 employees in 2015. Other U.S. steel companies also suffered from sluggish domestic and foreign demand. "Clearly, this is a rough patch," said Christopher Plummer, president and CEO of Metal Strategies.

These firms were dealing with changes in total spending, or *aggregate expenditure*. In this chapter, we will explore how changes in aggregate expenditure affect the level of total production in the economy.

Sources: Don Clark and Angela Chen, "Intel President Renée James to Leave as Others Also Depart," *Wall Street Journal*, July 2, 2015; Dan Gearino, "Worthington Industries to lay off 555 nationwide, including 80 in Fairfield County," *Columbus Dispatch*, March 25, 2015; John Carney, "Raising the Roof on Home Sales," *Wall Street Journal*, June 29, 2015; and Don Clark, "The Lawmaker: How Gordon Moore Predicted the Digital Revolution," *Wall Street Journal*, April 17, 2015.

Economics in Your Life

When Consumer Confidence Falls, Is Your Job at Risk?

Suppose that while attending college, you work part time at a company that manufactures door handles that it sells to automobile companies. One morning, you read in a news story online that consumer confidence in the economy has fallen, and, as a result, many households expect their future income to be well below their current income. Should you be concerned about losing your job? What factors should you consider in deciding how likely your company is to lay you off? As you read this chapter, try to answer these questions. You can check your answers against those we provide on **page 423** at the end of this chapter.

In Chapter 11, we discussed the determinants of long-run growth in the economy. We now turn to exploring the causes of the business cycle. We begin by examining the effect of changes in total spending on real gross domestic product (GDP).

Aggregate expenditure (AE) Total spending in the economy: the sum of consumption, planned investment, government purchases, and net exports.

During some years, total spending in the economy, or **aggregate expenditure (AE)**, and total production of goods and services increase by the same amount. In this case, most firms will sell about as much as they expected to sell, and they probably will not increase or decrease production or the number of workers they hire. During other years, total spending in the economy increases more than the production of goods and services. In those years, firms will increase production and hire more workers. But there are times, such as 2008 and early 2009, when total spending does not increase as much as total production. As a result, firms cut back on production and lay off workers, and the economy moves into a recession. In this chapter, we will explore why changes in total spending play such an important role in the economy.

Introductory Speech before NI determination: must read

12.1 The Aggregate Expenditure Model

LEARNING OBJECTIVE: Understand how macroeconomic equilibrium is determined in the aggregate expenditure model.

The business cycle involves the interaction of many economic variables. A simple model called the *aggregate expenditure model* can help us understand the relationships among some of these variables. Recall that GDP is the value of all the final goods and services produced in an economy during a particular year. Real GDP corrects nominal GDP for the effects of inflation. The **aggregate expenditure model** focuses on the short-run relationship between total spending and real GDP. An important assumption of the model is that the price level is constant. In Chapter 13, we will develop a more complete model of the business cycle that relaxes the assumption of constant prices.

Aggregate expenditure model A macroeconomic model that focuses on the short-run relationship between total spending and real GDP, assuming that the price level is constant.

The key idea of the aggregate expenditure model is that *in any particular year, the level of GDP is determined mainly by the level of aggregate expenditure.* To understand the relationship between aggregate expenditure and real GDP, we need to look more closely at the components of aggregate expenditure.

Aggregate Expenditure

Economists first began to study the relationship between changes in aggregate expenditure and changes in GDP during the Great Depression of the 1930s. The United States, the United Kingdom, and other industrial countries suffered declines in real GDP of 20 percent or more during the early 1930s. In 1936, the English economist John Maynard Keynes published a book, *The General Theory of Employment, Interest, and Money*, that systematically analyzed the relationship between changes in aggregate expenditure and changes in GDP. Keynes identified four components of aggregate expenditure that together equal GDP (these are the same four components we discussed in Chapter 8):

- ***Consumption (C).*** Spending by households on goods and services, such as automobiles and haircuts.
- ***Planned investment (I).*** Planned spending by firms on capital goods, such as factories, office buildings, and machine tools, and on research and development, and spending by households and firms on new houses.
- ***Government purchases (G).*** Spending by local, state, and federal governments on goods and services, such as aircraft carriers, bridges, and the salaries of FBI agents.
- ***Net exports (NX).*** Spending by foreign firms and households on goods and services produced in the United States minus spending by U.S. firms and households on goods and services produced in other countries.

So, we can write:

$$\text{Aggregate expenditure} = \text{Consumption} + \text{Planned investment} + \text{Government purchases} + \text{Net exports},$$

or:

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

Governments around the world gather statistics on aggregate expenditure on the basis of these four components. And economists and business analysts usually explain changes in GDP in terms of changes in these four components of spending. MyEconLab Concept Check

The Difference between Planned Investment and Actual Investment

Before considering further the relationship between aggregate expenditure and GDP, we need to consider an important distinction: Notice that *planned* investment spending, rather than actual investment spending, is a component of aggregate expenditure. You might wonder how the amount that businesses plan to spend on investment can be different from the amount they actually spend. We can begin resolving this puzzle by remembering that goods that have been produced but have not yet been sold are referred to as **inventories**. Changes in inventories are included as part of investment spending, along with spending on machinery, equipment, office buildings, and factories. We assume that the amount businesses plan to spend on machinery and office buildings is equal to the amount they actually spend, but the amount businesses plan to spend on inventories may be different from the amount they actually spend.

Inventories Goods that have been produced but not yet sold.

For example, Doubleday Publishing may print 1.5 million copies of the latest John Grisham novel, expecting to sell them all. If Doubleday does sell all 1.5 million, its inventories will be unchanged, but if it sells only 1.2 million, it will have an unplanned increase in inventories. In other words, changes in inventories depend on sales of goods, which firms cannot always forecast with perfect accuracy.

For the economy as a whole, we can say that actual investment spending will be greater than planned investment spending when there is an unplanned increase in inventories. Actual investment spending will be less than planned investment spending when there is an unplanned decrease in inventories. *Therefore, actual investment will equal planned investment only when there is no unplanned change in inventories.* In this chapter, we will use I to represent planned investment. We will also assume that the government data on investment spending compiled by the U.S. Bureau of Economic Analysis represents planned investment spending. This assumption is a simplification, however, because the government collects data on actual investment spending, which equals planned investment spending only when unplanned changes in inventories are zero. MyEconLab Concept Check

Macroeconomic Equilibrium

Macroeconomic equilibrium is similar to microeconomic equilibrium. In microeconomics, equilibrium in the apple market occurs when the quantity of apples demanded equals the quantity of apples supplied. When the apple market is in equilibrium, the quantity of apples produced and sold will not change unless the demand for apples or the supply of apples changes. For the economy as a whole, macroeconomic equilibrium occurs when total spending, or aggregate expenditure, equals total production, or GDP:

$$\text{Aggregate expenditure} = \text{GDP}.$$

As we have seen, over the *long run*, real GDP in the United States increases, and the standard of living rises (see Chapter 11). In this chapter, we are interested in understanding why GDP fluctuates in the *short run*. To simplify the analysis of macroeconomic equilibrium, we assume that the economy is not growing. In Chapter 13, we will

discuss the more realistic case of macroeconomic equilibrium in a growing economy. If we assume that the economy is not growing, then equilibrium GDP will not change unless aggregate expenditure changes.

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Adjustments to Macroeconomic Equilibrium

The apple market isn't always in equilibrium because sometimes the quantity of apples demanded is greater than the quantity supplied, and sometimes the quantity supplied is greater than the quantity demanded. The same outcome holds for the economy as a whole. Sometimes the economy is in macroeconomic equilibrium, and sometimes it isn't. When aggregate expenditure is greater than GDP, the total amount of spending in the economy is greater than the total amount of production. With spending being greater than production, many businesses will sell more goods and services than they had expected to sell. For example, the manager of a Home Depot store might like to keep 50 refrigerators in stock to give customers the opportunity to see a variety of different sizes and models. If sales are unexpectedly high, the store may have only 20 refrigerators in stock. In that case, the store will have an unplanned decrease in inventories: Its inventory of refrigerators will decline by 30.

How will the store manager react when more refrigerators are sold than expected? The manager is likely to order more refrigerators. If other stores selling refrigerators are experiencing similar sales increases and are also increasing their orders, then Whirlpool, KitchenAid, and other refrigerator manufacturers will significantly increase their production. These manufacturers may also increase the number of workers they hire. If the increase in sales is affecting not just refrigerators but also other appliances, automobiles, furniture, and other goods and services, then GDP and total employment will begin to increase. In summary, *when aggregate expenditure is greater than GDP, inventories will decline, and GDP and total employment will increase.*

Now suppose that aggregate expenditure is less than GDP. With spending being less than production, many businesses will sell fewer goods and services than they had expected to sell, so their inventories will increase. For example, the manager of the Home Depot store who wants 50 refrigerators in stock may find that because of slow sales, the store has 75 refrigerators, so the store manager will cut back on orders for new refrigerators. If other stores also cut back on their orders, General Electric and Whirlpool will reduce production and lay off workers.

If the decrease in sales is affecting not just refrigerators but also many other goods and services, GDP and total employment will begin to decrease. Falling sales followed by reductions in production and employment occurred at many firms during 2008. In summary, *when aggregate expenditure is less than GDP, inventories will increase, and GDP and total employment will decrease.*

Only when aggregate expenditure equals GDP will firms sell what they expected to sell. In that case, their inventories will be unchanged, and they will not have an incentive to increase or decrease production. The economy will be in macroeconomic equilibrium. Table 12.1 summarizes the relationship between aggregate expenditure and GDP.

Increases and decreases in aggregate expenditure cause the year-to-year changes we see in GDP. Economists devote considerable time and energy to forecasting what will happen to each component of aggregate expenditure. If economists forecast that

Table 12.1

The Relationship between Aggregate Expenditure and GDP

If . . .	then . . .	and . . .
aggregate expenditure is *equal* to GDP	inventories are *unchanged*	the economy is in *macroeconomic equilibrium.*
aggregate expenditure is *less* than GDP	inventories *rise*	GDP and employment *decrease.*
aggregate expenditure is *greater* than GDP	inventories *fall*	GDP and employment *increase.*

aggregate expenditure will decline in the future, that is equivalent to forecasting that GDP will decline and that the economy will enter a recession. Firms, policymakers, and individuals closely watch these forecasts because changes in GDP can have dramatic consequences. When GDP is increasing, so are wages, profits, and job opportunities. Declining GDP can be bad news for workers, firms, and job seekers.

When economists forecast that aggregate expenditure is likely to decline and that the economy is headed for a recession, the federal government may implement *macroeconomic policies* in an attempt to head off the decrease in expenditure and keep the economy from falling into recession. We will discuss these macroeconomic policies in Chapters 15 and 16.

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12.2 Determining the Level of Aggregate Expenditure in the Economy

LEARNING OBJECTIVE: Discuss the determinants of the four components of aggregate expenditure and define marginal propensity to consume and marginal propensity to save.

To better understand how macroeconomic equilibrium is determined in the aggregate expenditure model, we look more closely at the components of aggregate expenditure. Table 12.2 lists the four components of aggregate expenditure for 2014. The components are measured in *real* terms, which means that their values are corrected for inflation by being measured in billions of 2009 dollars. Consumption is clearly the largest component of aggregate expenditure. Investment and government purchases are of roughly similar size. Net exports was negative because in 2014, as in most years since the early 1970s, the United States imported more goods and services than it exported. Next, we consider the variables that determine each of the four components of aggregate expenditure.

Consumption

Figure 12.1 shows movements in real consumption from 1979 through the second quarter of 2015. Notice that consumption follows a smooth, upward trend. Only during periods of recession does the growth in consumption decline.

Here are the five most important variables that determine the level of consumption:

1. Current disposable income
2. Household wealth
3. Expected future income
4. The price level
5. The interest rate

Next we discuss how changes in each of these variables affect consumption.

Current Disposable Income The most important determinant of consumption is the current disposable income of households. Recall that disposable income is the income remaining to households after they have paid the personal income tax and received government *transfer payments*, such as Social Security payments (see Chapter 8). For most households, the higher their disposable income, the more they spend, and the lower their income, the less they spend. Macroeconomic consumption

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Table 12.2

Components of Real Aggregate Expenditure, 2014

Expenditure Category	Real Expenditure (billions of 2009 dollars)
Consumption	$10,876
Planned investment	2,718
Government purchases	2,838
Net exports	−443

Source: U.S. Bureau of Economic Analysis.

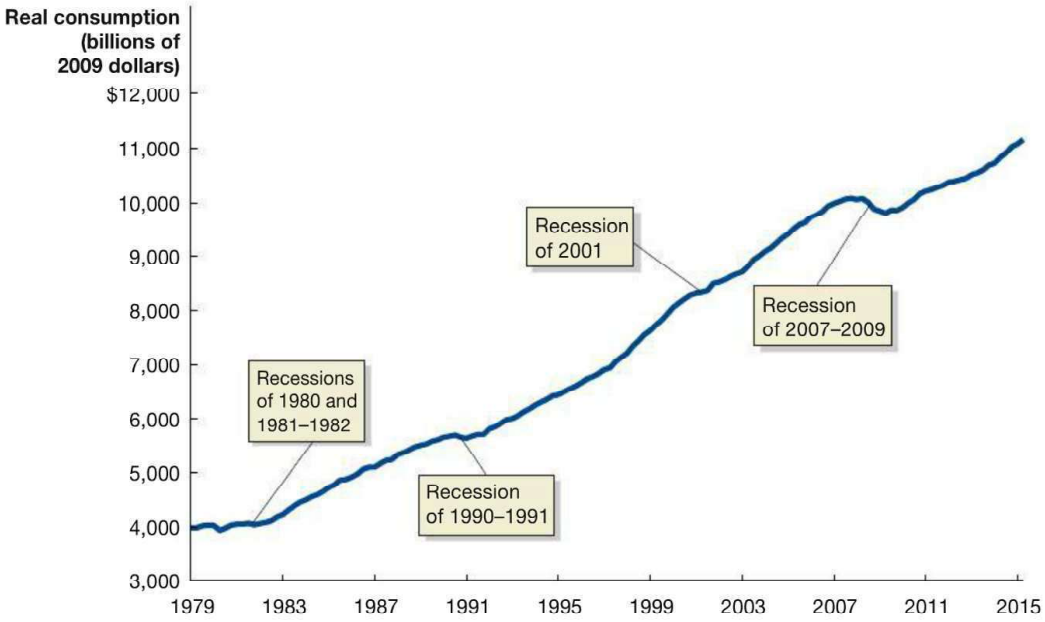

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Figure 12.1 **Real Consumption, 1979–2015**

Consumption follows a smooth, upward trend, interrupted only infrequently by brief recessions.

Note: The values are quarterly data seasonally adjusted at an annual rate.

Source: U.S. Bureau of Economic Analysis.

is the total of all the consumption of U.S. households. We would expect consumption to increase when the current disposable income of households increases and to decrease when the current disposable income of households decreases. As we have seen, total income in the United States expands during most years. Only during recessions, which happen infrequently, does total income decline. The main reason for the general upward trend in consumption shown in Figure 12.1 is that disposable income has followed a similar upward trend.

Household Wealth Consumption depends in part on the wealth of households. A household's *wealth* is the value of its *assets* minus the value of its *liabilities*. Recall that an asset is anything of value owned by a person or a firm, and a liability is anything owed by a person or a firm (see Chapter 6). A household's assets include its home, stock and bond holdings, and bank accounts. A household's liabilities include any loans that it owes. A household with $10 million in wealth is likely to spend more than a household with $10,000 in wealth, even if both households have the same disposable income. Therefore, when the wealth of households increases, consumption should increase, and when the wealth of households decreases, consumption should decrease. Shares of stock are an important category of household wealth. When stock prices increase, household wealth will increase, and so should consumption. For example, a family whose stock holdings increase in value from $30,000 to $100,000 may be willing to spend a larger fraction of its income because it is less concerned with adding to its savings. A decline in stock prices should lead to a decline in consumption. Economists who have studied the determinants of consumption have concluded that permanent increases in wealth have a larger impact than temporary increases. One estimate of the effect of changes in wealth on consumption spending indicates that, for every permanent $1 increase in household wealth, consumption spending will increase by between 4 and 5 cents per year.

Expected Future Income Consumption depends in part on expected future income. Most people prefer to keep their consumption fairly stable from year to year,

even if their income fluctuates significantly. Some salespeople, for example, earn most of their income from commissions, which are fixed percentages of the prices of the products they sell. A salesperson might have a high income in some years and a much lower income in other years. Most people in this situation keep their consumption steady and do not increase it during good years and then drastically cut it back during slower years. If we looked only at the current income of someone in this situation, we might have difficulty estimating the person's current consumption. Instead, we need to take into account the person's expected future income. We can conclude that current income explains current consumption well *but only when current income is not unusually high or unusually low compared with expected future income.*

The Price Level Recall that the *price level* measures the average prices of goods and services in the economy (see Chapter 9). Changes in the price level affect consumption. It is tempting to think that an increase in prices will reduce consumption by making goods and services less affordable. In fact, the effect of an increase in the price of *one* product on the quantity demanded of that product is different from the effect of an increase in the price level on *total* spending by households on goods and services. Changes in the price level affect consumption mainly through their effect on household wealth. An increase in the price level will result in a decrease in the *real* value of household wealth. For example, if you have $2,000 in a checking account, the higher the price level, the fewer goods and services you can buy with your money. Therefore, as the price level rises, the real value of your wealth declines, and so will your consumption, at least a little. Conversely, if the price level falls—which happens rarely in the United States—the real value of your $2,000 increases, and your consumption will also increase.

The Interest Rate Finally, consumption depends on the interest rate. When the interest rate is high, the reward for saving is increased, and households are likely to save more and spend less. Recall the distinction between the *nominal interest rate* and the *real interest rate* (see Chapter 9):

- The nominal interest rate is the stated interest rate on a loan or a financial investment such as a bond.
- The real interest rate corrects the nominal interest rate for the effect of inflation and is equal to the nominal interest rate minus the inflation rate.

Because households are concerned with the payments they will make or receive after the effects of inflation are taken into account, consumption spending depends on the real interest rate.

We have seen that consumption spending is divided into three categories:

1. Spending on *services*, such as medical care, education, and haircuts
2. Spending on *nondurable goods*, such as food and clothing
3. Spending on *durable goods*, such as automobiles and furniture

Spending on durable goods is most likely to be affected by changes in the interest rate because a high real interest rate increases the cost of spending financed by borrowing. The monthly payment on a four-year car loan will be higher if the real interest rate on the loan is 6 percent than if it is 4 percent.

The Consumption Function Panel (a) in Figure 12.2 illustrates the relationship between consumption and disposable income during the years 1960 to 2014. In panel (b), we draw a straight line through the points representing consumption and disposable income. The fact that most of the points lie almost on the line shows the close relationship between consumption and disposable income. Because changes in consumption depend on changes in disposable income, we can say that *consumption is a function of disposable income*. The relationship between consumption spending and disposable income illustrated in panel (b) of Figure 12.2 is called the **consumption function**.

Consumption function The relationship between consumption spending and disposable income.

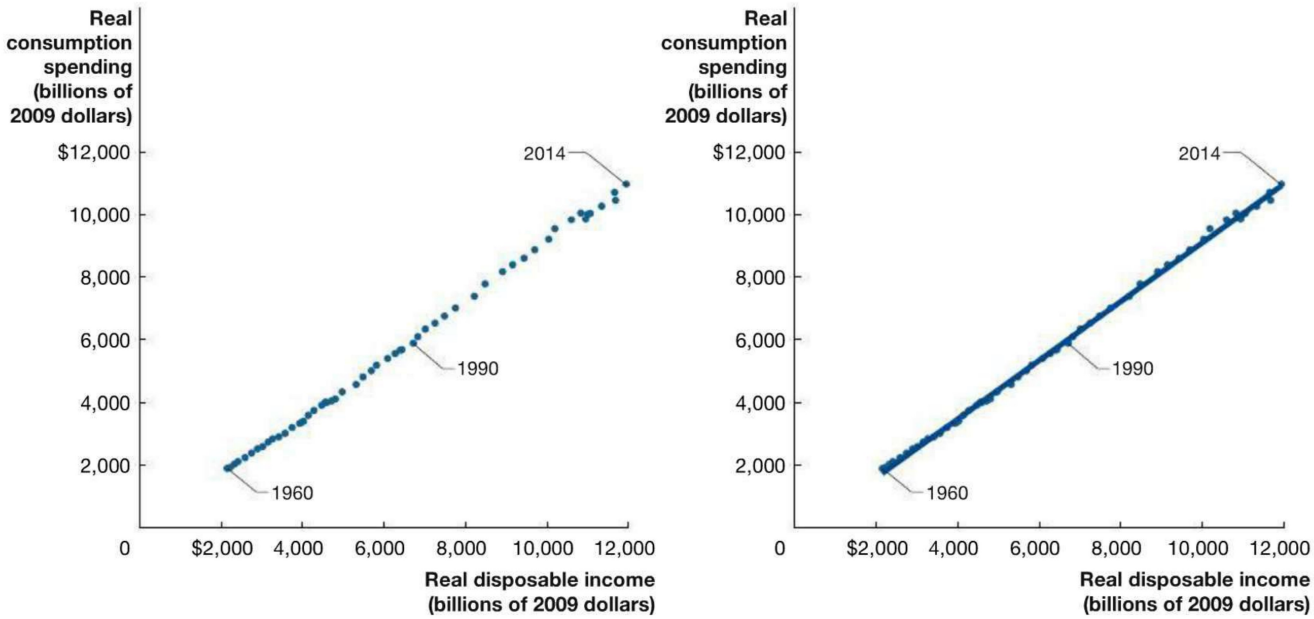

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Figure 12.2 The Relationship between Consumption and Income, 1960–2014

Panel (a) shows the relationship between consumption and income. The points represent combinations of real consumption spending and real disposable income for the years 1960 to 2014. In panel (b), we draw a straight line through the points from panel (a). The line, which represents the relationship between consumption and disposable income, is called the *consumption function*. The slope of the consumption function is the marginal propensity to consume.

Source: U.S. Bureau of Economic Analysis.

Marginal propensity to consume (*MPC*) The slope of the consumption function: The amount by which consumption spending changes when disposable income changes.

The slope of the consumption function, which is equal to the change in consumption divided by the change in disposable income, is called the **marginal propensity to consume (*MPC*)**. Using the Greek letter delta, Δ, to represent "change in," C to represent consumption spending, and YD to represent disposable income, we can write the expression for the *MPC* as follows:

$$MPC = \frac{\text{Change in consumption}}{\text{Change in disposable income}} = \frac{\Delta C}{\Delta YD}.$$

For example, between 2013 and 2014, consumption spending increased by $285 billion, while disposable income increased by $313 billion. The marginal propensity to consume was, therefore:

$$\frac{\Delta C}{\Delta YD} = \frac{\$285 \text{ billion}}{\$313 \text{ billion}} = 0.91.$$

The value for the *MPC* tells us that households in 2014 spent 91 percent of the increase in their disposable income.

We can also use the *MPC* to determine how much consumption will change as income changes. To see this relationship, we rewrite the expression for the *MPC*:

$$\text{Change in consumption} = \text{Change in disposable income} \times MPC.$$

For example, with an *MPC* of 0.91, a $10 billion increase in disposable income will increase consumption by $10 billion × 0.91, or $9.1 billion. MyEconLab Concept Check

The Relationship between Consumption and National Income

We have seen that consumption spending by households depends on disposable income. We now shift our focus slightly to the similar relationship that exists between

consumption spending and GDP. We make this shift because we are interested in using the aggregate expenditure model to explain changes in real GDP rather than changes in disposable income. The first step in examining the relationship between consumption and GDP is to recall that the differences between GDP and national income are small and can be ignored without affecting our analysis (see Chapter 8). In fact, in this and the following chapters, we will use the terms *GDP* and *national income* interchangeably. Also recall that disposable income is equal to national income plus government transfer payments minus taxes. Taxes minus government transfer payments are called *net taxes*. So, we can write the following:

GDP = NI

$$\text{Disposable income} = \text{National income} - \text{Net taxes}.$$

We can rearrange the equation like this:

$$\text{National income} = \text{GDP} = \text{Disposable income} + \text{Net taxes}.$$

The table in Figure 12.3 shows hypothetical values for national income (or GDP), net taxes, disposable income, and consumption spending. Notice that national income and disposable income differ by a constant amount, which is equal to net taxes of $1,000 billion. In reality, net taxes are not a constant amount because they are affected by changes in income. As income rises, net taxes rise because some taxes, such as the personal income tax, increase and some government transfer payments, such as government payments to unemployed workers, fall. Nothing important is affected in our analysis, however, by our simplifying assumption that net taxes are constant.

National Income or GDP (billions of dollars)	Net Taxes (billions of dollars)	Disposable Income (billions of dollars)	Consumption (billions of dollars)	Change in National Income (billions of dollars)	Change in Disposable Income (billions of dollars)
$1,000	$1,000	$0	$750	—	—
3,000	1,000	2,000	2,250	$2,000	$2,000
5,000	1,000	4,000	3,750	2,000	2,000
7,000	1,000	6,000	5,250	2,000	2,000
9,000	1,000	8,000	6,750	2,000	2,000
11,000	1,000	10,000	8,250	2,000	2,000
13,000	1,000	12,000	9,750	2,000	2,000

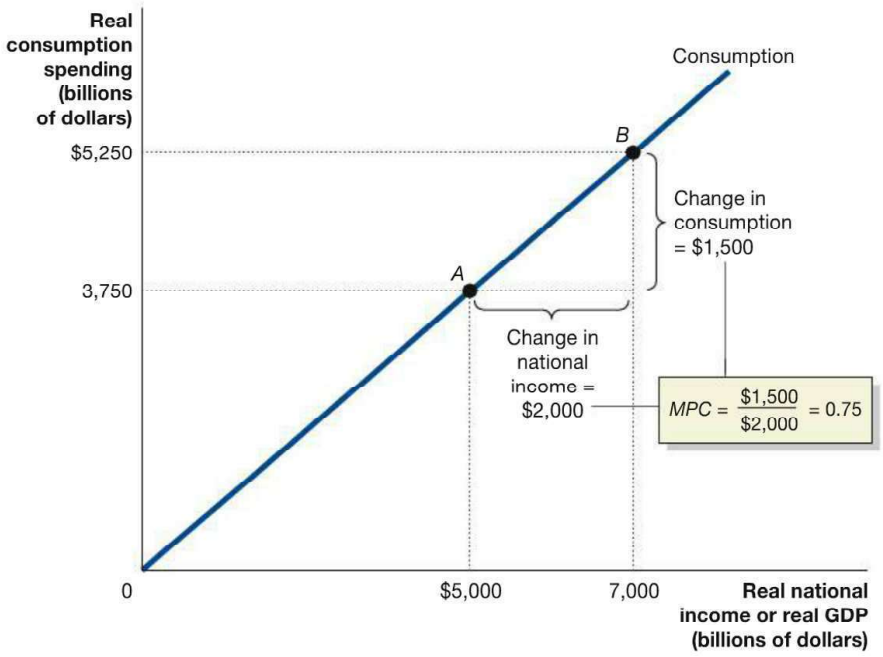

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Figure 12.3

The Relationship between Consumption and National Income

Because national income differs from disposable income only by net taxes—which, for simplicity, we assume are constant—we can graph the consumption function using national income rather than disposable income. We can also calculate the *MPC*, which is the slope of the consumption function, using either the change in national income or the change in disposable income and always get the same value. The slope of the consumption function between points *A* and *B* is equal to the change in consumption—$1,500 billion—divided by the change in national income—$2,000 billion—or 0.75.

The graph in Figure 12.3 shows a line representing the relationship between consumption and national income. The line is very similar to the consumption function shown in panel (b) of Figure 12.2. We defined the marginal propensity to consume (*MPC*) as the change in consumption divided by the change in disposable income, which is the slope of the consumption function. In fact, notice that if we calculate the slope of the line in Figure 12.3 between points *A* and *B*, we get a result that will not change whether we use the values for national income or the values for disposable income. Using the values for national income:

$$\frac{\Delta C}{\Delta Y} = \frac{\$5{,}250 \text{ billion} - \$3{,}750 \text{ billion}}{\$7{,}000 \text{ billion} - \$5{,}000 \text{ billion}} = 0.75.$$

Using the corresponding values for disposable income from the table:

$$\frac{\Delta C}{\Delta YD} = \frac{\$5{,}250 \text{ billion} - \$3{,}750 \text{ billion}}{\$6{,}000 \text{ billion} - \$4{,}000 \text{ billion}} = 0.75.$$

It should not be surprising that we get the same result in either case. National income and disposable income differ by a constant amount, so changes in the two numbers always give us the same value, as shown in the last two columns of the table in Figure 12.3. Therefore, we can graph the consumption function using national income rather than using disposable income. We can also calculate the *MPC* using either the change in national income or the change in disposable income and always get the same value.

Income, Consumption, and Saving

To complete our discussion of consumption, we can look briefly at the relationships among income, consumption, and saving. Households spend their income, save it, or use it to pay taxes. For the economy as a whole, we can write the following:

$$\text{National income} = \text{Consumption} + \text{Saving} + \text{Taxes}.$$

When national income increases, there must be some combination of an increase in consumption, an increase in saving, and an increase in taxes:

$$\text{Change in national income} = \text{Change in consumption} + \text{Change in saving} + \text{Change in taxes}.$$

Using symbols, where *Y* represents national income (and GDP), *C* represents consumption, *S* represents saving, and *T* represents taxes, we can write the following:

$$Y = C + S + T$$

and:

$$\Delta Y = \Delta C + \Delta S + \Delta T.$$

To simplify, we can assume that taxes are always a constant amount, in which case $\Delta T = 0$, so the following is also true:

$$\Delta Y = \Delta C + \Delta S.$$

Marginal propensity to save (*MPS*) The amount by which saving changes when disposable income changes.

We have already seen that the marginal propensity to consume equals the change in consumption divided by the change in income. We can define the **marginal propensity to save (*MPS*)** as the amount by which saving changes when disposable income changes. We can measure the *MPS* as the change in saving divided by the change in disposable income. In calculating the *MPS*, as in calculating the *MPC*, we can safely ignore the difference between national income and disposable income.

If we divide the previous equation by the change in income, ΔY, we get an equation that shows the relationship between the marginal propensity to consume and the marginal propensity to save:

$$\frac{\Delta Y}{\Delta Y} = \frac{\Delta C}{\Delta Y} + \frac{\Delta S}{\Delta Y},$$

or:

$$1 = MPC + MPS.$$

This equation tells us that when taxes are constant, the marginal propensity to consume plus the marginal propensity to save must always equal 1. They must add up to 1 because part of any increase in income is consumed, and whatever remains must be saved. MyEconLab Concept Check

Solved Problem 12.2

Calculating the Marginal Propensity to Consume and the Marginal Propensity to Save

Fill in the blank cells in the following table. For simplicity, assume that taxes are zero. Show that the *MPC* plus the *MPS* equals 1.

National Income and Real GDP (*Y*)	Consumption (*C*)	Saving (*S*)	Marginal Propensity to Consume (*MPC*)	Marginal Propensity to Save (*MPS*)
$9,000	$8,000			
10,000	8,600			
11,000	9,200			
12,000	9,800			
13,000	10,400			

Solving the Problem

Step 1: **Review the chapter material.** This problem is about the relationship among income, consumption, and saving, so you may want to review the section "Income, Consumption, and Saving," which begins on page 398.

Step 2: **Fill in the table.** We know that $Y = C + S + T$. With taxes equal to zero, this equation becomes $Y = C + S$. We can use this equation to fill in the "Saving" column. We can use the equations for the *MPC* and the *MPS* to fill in the other two columns:

$$MPC = \frac{\Delta C}{\Delta Y}$$

$$MPS = \frac{\Delta S}{\Delta Y}$$

For example, to calculate the value of the *MPC* in the second row, we have:

$$MPC = \frac{\Delta C}{\Delta Y} = \frac{\$8{,}600 - \$8{,}000}{\$10{,}000 - \$9{,}000} = \frac{\$600}{\$1{,}000} = 0.6.$$

To calculate the value of the *MPS* in the second row, we have:

$$MPS = \frac{\Delta S}{\Delta Y} = \frac{\$1{,}400 - \$1{,}000}{\$10{,}000 - \$9{,}000} = \frac{\$400}{\$1{,}000} = 0.4.$$

National Income and Real GDP (*Y*)	Consumption (*C*)	Saving (*S*)	Marginal Propensity to Consume (*MPC*)	Marginal Propensity to Save (*MPS*)
$9,000	$8,000	$1,000	—	—
10,000	8,600	1,400	0.6	0.4
11,000	9,200	1,800	0.6	0.4
12,000	9,800	2,200	0.6	0.4
13,000	10,400	2,600	0.6	0.4

Step 3: **Show that the *MPC* plus the *MPS* equals 1.** At every level of national income, the *MPC* is 0.6 and the *MPS* is 0.4. Therefore, the *MPC* plus the *MPS* is always equal to 1.

Your Turn: For more practice, do related problem 2.10 on page 425 at the end of this chapter.

Planned Investment

Figure 12.4 shows movements in real investment spending from 1979 through the second quarter of 2015. Notice that, unlike consumption, investment does not follow a smooth, upward trend. Investment declined significantly during the recessions of 1980, 1981–1982, 1990–1991, 2001, and 2007–2009.

These are the four most important variables that determine the level of investment:

1. Expectations of future profitability
2. The interest rate
3. Taxes
4. Cash flow

Expectations of Future Profitability Investment goods, such as factories, office buildings, and machinery and equipment, are long-lived. A firm is unlikely to build a new factory unless it is optimistic that the demand for its product will remain strong for at least several years. When the economy moves into a recession, many firms postpone buying investment goods even if the demand for their own product is strong

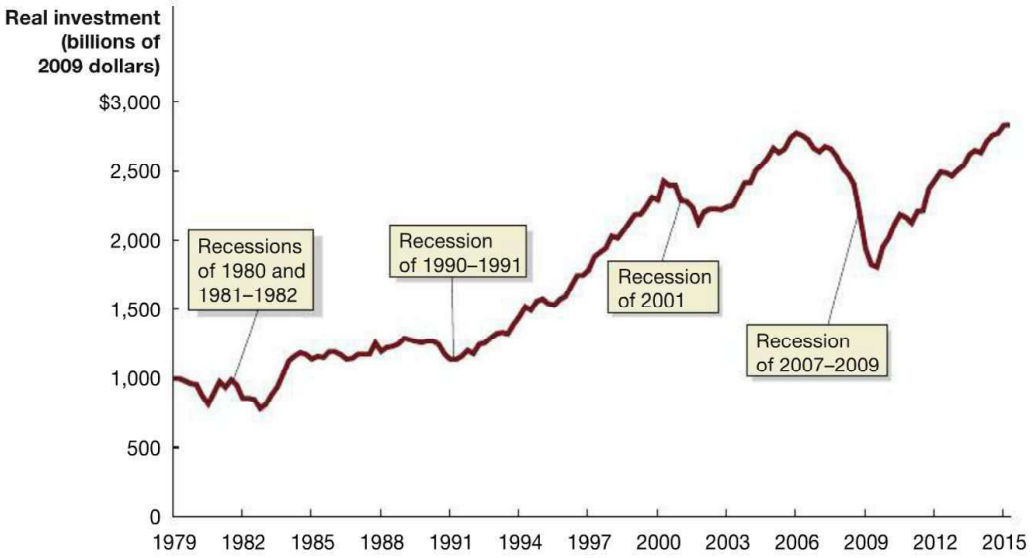

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Figure 12.4 **Real Investment, 1979–2015**

Investment is subject to larger changes than is consumption. Investment declined significantly during the recessions of 1980, 1981–1982, 1990–1991, 2001, and 2007–2009.

Note: The values are quarterly data, seasonally adjusted at an annual rate.

Source: U.S. Bureau of Economic Analysis.

because they are afraid that the recession may become worse. During an expansion, some firms may become optimistic and begin to increase spending on investment goods even before the demand for their own product has increased. The key point is that *the optimism or pessimism of firms is an important determinant of investment spending.*

Residential construction is included in investment spending. Since 1990, residential construction has averaged about 30 percent of total investment spending. But the swings in residential construction have been quite substantial, ranging from a high of 36 percent of investment spending at the height of the housing boom in 2005 down to 18 percent in 2011. The sharp decline in spending on residential construction beginning in 2006 helped to cause the 2007–2009 recession and contributed to its severity.

The Interest Rate Some business investment is financed by borrowing, as firms issue corporate bonds or receive loans from banks. Households also borrow to finance most of their spending on new homes. The higher the interest rate, the more expensive it is for firms and households to borrow. Because households and firms are interested in the cost of borrowing after taking into account the effects of inflation, investment spending depends on the real interest rate. Therefore, holding constant the other factors that affect investment spending, there is an inverse relationship between the real interest rate and investment spending: *A higher real interest rate results in less investment spending, and a lower real interest rate results in more investment spending.* The ability of households to borrow money at very low real interest rates helps explain the rapid increase in spending on residential construction from 2002 to 2006.

Taxes Taxes affect the level of investment spending. Firms focus on the profits that remain after they have paid taxes. The federal government imposes a *corporate income tax* on the profits corporations earn, including profits from the new buildings, equipment, and other investment goods they purchase. A reduction in the corporate income tax increases the after-tax profitability of investment spending. An increase in the corporate income tax decreases the after-tax profitability of investment spending. *Investment tax incentives* increase investment spending. An investment tax incentive provides firms with a tax reduction when they buy new investment goods.

Cash Flow Most firms do not borrow to finance spending on new factories, machinery, and equipment. Instead, they use their own funds. **Cash flow** is the difference between the cash revenues received by a firm and the cash spending by the firm. Neither noncash receipts nor noncash spending is included in cash flow. For example, tax laws allow firms to count the depreciation of worn-out or obsolete machinery and equipment as a cost, even if new machinery and equipment have not actually been purchased. Because this is noncash spending, firms do not include it when calculating cash flow. The largest contributor to cash flow is profit. The more profitable a firm is, the greater its cash flow and the greater its ability to finance investment. During periods of recession, many firms experience reduced profits, which in turn reduces their ability to finance spending on new factories or machinery and equipment.

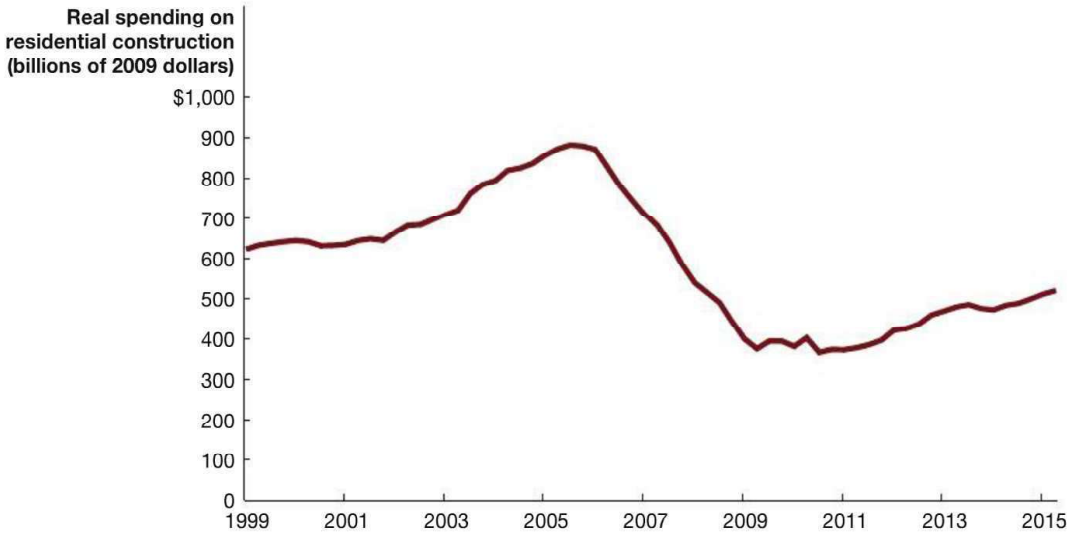
Cash flow The difference between the cash revenues received by a firm and the cash spending by the firm.

Making the Connection MyEconLab Video

Is Student Loan Debt Causing Fewer Young People to Buy Houses?

Although our discussion in this section has concentrated on the components of investment that represent spending by businesses, household purchases of new homes are an important part of investment spending. As the graph on the next page shows, spending on residential construction rose rapidly in the period just before the recession of 2007–2009, declined dramatically during the recession, and recovered only slowly thereafter. The slow recovery in spending on residential construction is one reason the recovery from the recession was weaker than most recoveries.

Some economists believe that one factor holding back recovery in the housing market was low home-buying rates among younger households. In 2014, homeownership rates among people younger than 35 were the lowest they have been in the United States in at least 25 years. Do high levels of student debt explain why young people are buying fewer homes? If you have a college degree, you are likely to earn more than



people without a college degree. So, many people consider student debt taken on to earn a degree to be a good investment. For the class of 2014, the average student debt per borrower was a record $33,000. Total student debt in 2014 was $1.1 trillion, more than the amount that all Americans owe on credit cards or automobile loans, and twice the level of student debt in 2007. Does increasing student debt explain the decline in home purchases among younger households? Economists differ in their answers to this question because other factors may be affecting homeownership rates.

Harvard economist and former Obama administration economic adviser Larry Summers argues that many college graduates have trouble accumulating the funds for a down payment on a house because they are making student loan payments. He also argues that these payments have led young college graduates to delay forming families, thereby reducing their need to move from an apartment to a house. One survey indicates that 45 percent of college graduates under age 24 are living at home or with another family member. Some economists point to rising delinquency rates on student loans as a factor that makes it difficult for some young college graduates to qualify for a mortgage loan necessary to buy a house.

Other economists are skeptical of a link between student debt and a reduced demand for housing by young college graduates. Economists who have carried out statistical studies of the link have arrived at mixed results. In testifying before Congress, Federal Reserve Chair Janet Yellen remarked of the connection between students' debt and the demand for housing that "I don't know of clear evidence of it."

Some economists believe that new government lending guidelines may be playing a role. When deciding whether to grant a mortgage loan, banks and other lenders have interpreted the guidelines to mean that they must give greater consideration to how much debt graduates have. As a result, fewer young college graduates qualify for mortgage loans. Finally, some economists argue that the weak recovery of the U.S. labor market from the recession of 2007–2009 is the key reason that young college graduates have been buying fewer houses. With unemployment rates remaining high and wages growing slowly, many young people have difficulty affording homes, even if they have limited or no student debt. As the recovery became stronger in 2015, these economists expected that younger people would be increasing their demand for housing.

Sources: Mitchell E. Daniels, "How Student Debt Harms the Economy," *Wall Street Journal*, January 27, 2015; Zeppo Mitchell, "Larry Summers: Student Debt Is Slowing the U.S. Housing Recovery," *Wall Street Journal*, May 21, 2014; Josh Mitchell, "Student Debt Takes a Toll on Some Home Buyers," *Wall Street Journal*, June 20, 2014; Susan Dynarski, "Remember the Problems with Mortgage Defaults? They're Coming Back with Student Loans," *New York Times*, June 12, 2014; Meta Brown, et al., "Measuring Student Debt and Its Performance," Federal Reserve Bank of New York, Staff Report No. 668, April 2014; and U.S. Bureau of Economic Analysis.

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Your Turn: Test your understanding by doing related problem 2.11 on page 425 at the end of this chapter.

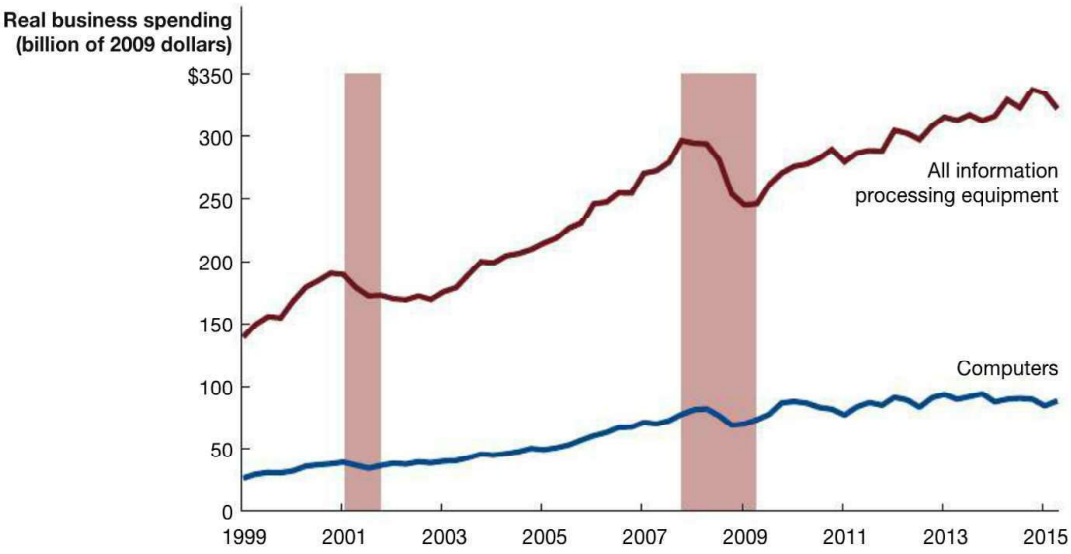

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Figure 12.5 **Spending on Information Processing Equipment, 1999–2015**

Business spending on information processing equipment, particularly computers, has grown only slowly since the end of the recession of 2007–2009. **Source:** U.S. Bureau of Economic Analysis.

The Surprisingly Slow Growth of Business Spending on Information Processing Equipment In recent years, most businesses have increased their use of information technology in a variety of ways, including expanding their presence on the Internet, especially by using social networking apps such as Twitter, Instagram, and Facebook; designing company apps; and providing employees with tablets and smartphones. As Figure 12.5 shows, though, the focus of many businesses on information technology is not reflected in spending on information processing equipment. The blue line shows spending on computers, printers, and related equipment, while the red line shows spending on all information processing equipment, which in addition to computers, includes photocopiers, fax machines, and other office equipment. In 2015, total spending on information processing equipment had grown by less than 10 percent from its levels at the beginning of the recession in 2007. Spending on computers was also growing slowly and in 2015 was barely above 2010 levels.

A key reason for this slow growth in spending on information technology equipment is that over time, the frontier of developments in information technology has shifted away from equipment—particularly computers and servers—and toward software, such as apps used on smartphones and tablets. This shift has been bad news for firms like Intel, whose sales of processors are heavily dependent on sales of computers. Intel has had only mixed success in reducing its dependence on sales to computer manufacturers by shifting toward making components for tablets, smartwatches, and smartphones, including a modem chip for Apple's iPhone.

Government Purchases

Total government purchases include all spending by federal, local, and state governments for goods and services. Recall that government purchases do not include transfer payments, such as Social Security payments by the federal government or pension payments by local governments to retired police officers and firefighters, because the government does not receive a good or service in return (see Chapter 8).

Figure 12.6 shows levels of real government purchases from 1979 through the second quarter of 2015. Government purchases grew steadily for most of this period,

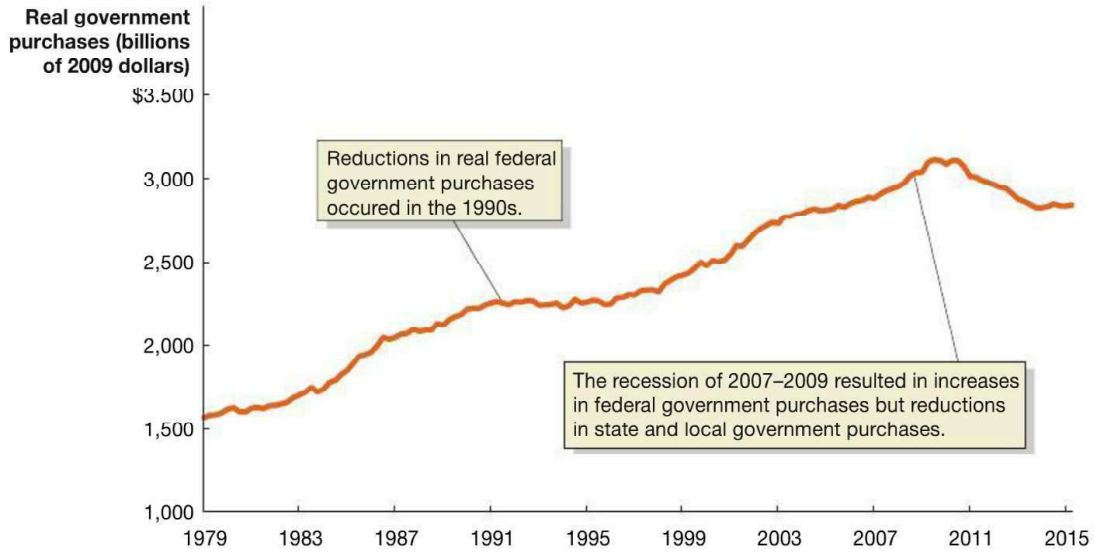

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Figure 12.6 Real Government Purchases, 1979–2015

Government purchases grew steadily for most of the 1979–2015 period, with the exception of the early 1990s, when concern about the federal budget deficit caused real government purchases to fall for three years, beginning in 1992, and the period following the recession of 2007–2009 when many state and local governments reduced spending.

Note: The values are quarterly data, seasonally adjusted at an annual rate.

Source: U.S. Bureau of Economic Analysis.

with the exception of the early 1990s and the period following the end of the recession of 2007–2009. During the early 1990s, Congress and Presidents George H. W. Bush and Bill Clinton enacted a series of spending reductions after they became concerned that spending by the federal government was growing much faster than tax receipts. As a result, real government purchases declined for three years beginning in 1992. Contributing to the slow growth of government purchases during the 1990s was the end of the Cold War between the United States and the Soviet Union in 1989. Real federal government spending on national defense declined by 24 percent from 1990 to 1998, before rising by 60 percent between 1998 and 2010 in response to the war on terrorism and the wars in Iraq and Afghanistan. As those wars wound down, defense spending declined by 18 percent between 2010 and 2015. Total federal government purchases increased in 2009 and 2010, as President Barack Obama and Congress attempted to offset declining consumption and investment spending during the recession. Federal government purchases then declined beginning in 2011 and continuing through 2015. The recession and the slow recovery resulted in declining tax revenues to state and local governments. As a result, real state and local government purchases declined between 2009 and 2013, before increasing, along with tax revenues, beginning in 2014.

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Net Exports

Net exports equal exports minus imports. We can calculate net exports by taking the value of spending by foreign firms and households on goods and services produced in the United States and *subtracting* the value of spending by U.S. firms and households on goods and services produced in other countries. Figure 12.7 illustrates movements in real net exports from 1979 through the second quarter of 2015. During nearly all these years, the United States imported more goods and services than it exported, so net exports were negative. Net exports usually increase when the U.S. economy is in a recession—although they fell during the 2001 recession—and fall when the U.S. economy is in an expansion.

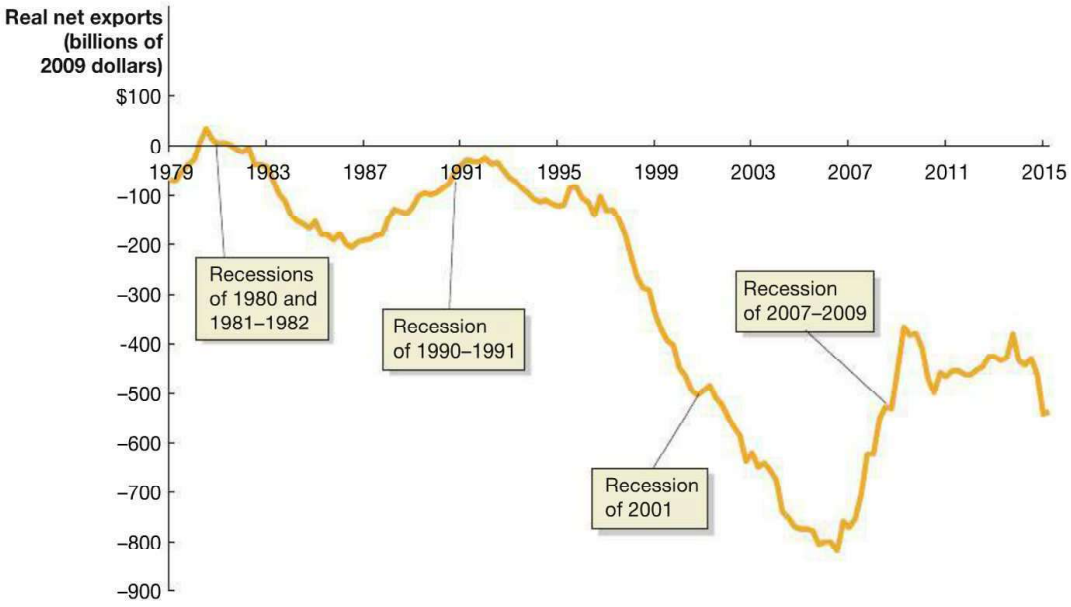

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Figure 12.7 Real Net Exports, 1979–2015

Net exports were negative in most years between 1979 and 2015. Net exports have usually increased when the U.S. economy is in a recession and decreased when the U.S. economy is in an expansion, although they fell during the 2001 recession.

Note: The values are quarterly data, seasonally adjusted at an annual rate.

Source: U.S. Bureau of Economic Analysis.

The following are the three most important variables that determine the level of net exports:

1. The price level in the United States relative to the price levels in other countries
2. The growth rate of GDP in the United States relative to the growth rates of GDP in other countries
3. The exchange rate between the dollar and other currencies

The Price Level in the United States Relative to the Price Levels in Other Countries If inflation in the United States is lower than inflation in other countries, prices of U.S. products increase more slowly than the prices of products in other countries. This slower increase in the U.S. price level increases the demand for U.S. products relative to the demand for foreign products. So, U.S. exports increase and U.S. imports decrease, which increases net exports. The reverse happens during periods when the inflation rate in the United States is higher than the inflation rates in other countries: U.S. exports decrease and U.S. imports increase, which decreases net exports.

The Growth Rate of GDP in the United States Relative to the Growth Rates of GDP in Other Countries As GDP increases in the United States, the incomes of households rise, leading them to increase their purchases of goods and services. Some of the additional goods and services purchased with rising incomes are produced in the United States, but some are imported. When incomes rise faster in the United States than in other countries, U.S. consumers' purchases of foreign goods and services increase faster than foreign consumers' purchases of U.S. goods and services. As a result, net exports fall. When incomes in the United States rise more slowly than incomes in other countries, net exports rise.

The Exchange Rate between the Dollar and Other Currencies As the value of the U.S. dollar rises, the foreign currency price of U.S. products sold in other countries rises, and the dollar price of foreign products sold in the United States falls.

For example, suppose that the exchange rate between the Japanese yen and the U.S. dollar is 100 Japanese yen for 1 U.S. dollar, or ¥100 = $1. At this exchange rate, someone in the United States could buy ¥100 in exchange for $1, or someone in Japan could buy $1 in exchange for ¥100. Leaving aside transportation costs, at this exchange rate, a U.S. product that sells for $1 in the United States will sell for ¥100 in Japan, and a Japanese product that sells for ¥100 in Japan will sell for $1 in the United States. If the exchange rate changes to ¥150 = $1, then the value of the dollar will have risen because it takes more yen to buy $1. At the new exchange rate, the U.S. product that still sells for $1 in the United States will now sell for ¥150 in Japan, reducing the quantity demanded by Japanese consumers. The Japanese product that still sells for ¥100 in Japan will now sell for only $0.67 in the United States, increasing the quantity demanded by U.S. consumers. An increase in the value of the dollar will reduce exports and increase imports, so net exports will fall. A decrease in the value of the dollar will increase exports and reduce imports, so net exports will rise.

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Making the Connection

MyEconLab Video

The iPhone Is Made in China ... or Is It?

The box says iPhones are made in China, but are they?

Designers and software engineers at Apple in Cupertino, California, designed the iPhone. However, the iPhone is sold in a box labeled "Made in China." The price of the iPhone when it is shipped from a factory in China is about $275. (The retail price is higher because Apple adds a markup, as do Best Buy and other stores that sell the iPhone.) So if you buy an iPhone, the purchase enters the GDP statistics as a $275 import to the United States from China. Recently, economists have begun to question whether the standard way of keeping track of imports and exports accurately reflects how modern businesses operate.

Recall from Chapter 2 that the iPhone contains components that are produced by a number of firms, based in several different countries, including the United States. Apple uses this *global supply chain* to take advantage of both lower production costs in other countries and the ability of different firms to use their engineering and manufacturing skills to produce the iPhone's many components. Apple arranges for these firms to ship the components to factories in China for final assembly. These Chinese factories are owned by Foxconn, a firm based in Taiwan. So, only final assembly of the iPhone takes place in China; no Chinese firm makes any of the iPhone's components.

How much of the price of the iPhone is accounted for by the value of final assembly? According to a study by economists Yuqing Xing and Neal Detert of the Asian Development Bank, less than 4 percent. In fact, they note that the value of the iPhone components China imports from U.S. firms is greater than the value of assembling the iPhones in Chinese factories. As measured in the GDP statistics, in 2015 the United States imported more than $20 billion worth of iPhones from China. In fact, most of that $20 billion represents the value of the iPhone's components, none of which are made in China.

The current system of accounting for imports and exports in the GDP statistics dates to a time when most products were produced entirely within one country. So a good the United States imported from France or Japan would have been produced completely in that country. As large firms have increasingly relied on global supply chains, the statistics on imports and exports have failed to keep up. As Pascal Lamy of the World Trade Organization put it: "The concept of country of origin for manufactured goods has gradually become obsolete." In other words, "trade statistics can mislead as much as inform," as economists Kenneth Kraemer of the University of

California, Irvine, Greg Linden of the University of California, Berkeley, and Jason Dedrick of Syracuse University put it. The U.S. Bureau of Economic Analysis and the government statistical agencies in other countries are all aware of the flaws that have developed in accounting for imports and exports. But the complexity of global supply chains makes it difficult to develop more accurate measures of imports and exports.

Sources: Izabella Kaminska, "iPhone6, the GDP Effect," ftalphaville.ft.com, September 2, 2014; Phil Izzo, "Who Gets Credit for iPhone Trade," *Wall Street Journal*, March 17, 2012; Kenneth L. Kraemer, Greg Linden, and Jason Dedrick, "Capturing Value in Global Networks: Apple's iPad and iPhone," University of California, Irvine, Working paper, July 2011; Yuqing Xing and Neal Detert, "How the iPhone Widens the United States Trade Deficit with the People's Republic of China," ADBI Working Paper Series, No. 257, May 2011; and Andrew Batson, "Not Really, 'Made in China,'" *Wall Street Journal*, December 15, 2010.

Your Turn: Test your understanding by doing related problems 2.13 and 2.14 on page 426 at the end of this chapter.

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12.3 Graphing Macroeconomic Equilibrium

LEARNING OBJECTIVE: Use a 45°-line diagram to illustrate macroeconomic equilibrium.

Having examined the components of aggregate expenditure, we can now look more closely at macroeconomic equilibrium. We saw earlier in the chapter that macroeconomic equilibrium occurs when GDP is equal to aggregate expenditure. We can use a graph called the *45°-line diagram* to illustrate macroeconomic equilibrium. (The 45°-line diagram is also sometimes called the *Keynesian cross* because it is based on the analysis of John Maynard Keynes.) To become familiar with this diagram, consider Figure 12.8, which is a 45°-line diagram that shows the relationship between the quantity of Pepsi sold (on the vertical axis) and the quantity of Pepsi produced (on the horizontal axis).

The line on the diagram forms an angle of 45° with the horizontal axis. The line represents all the points that are equal distances from both axes. So, points such as

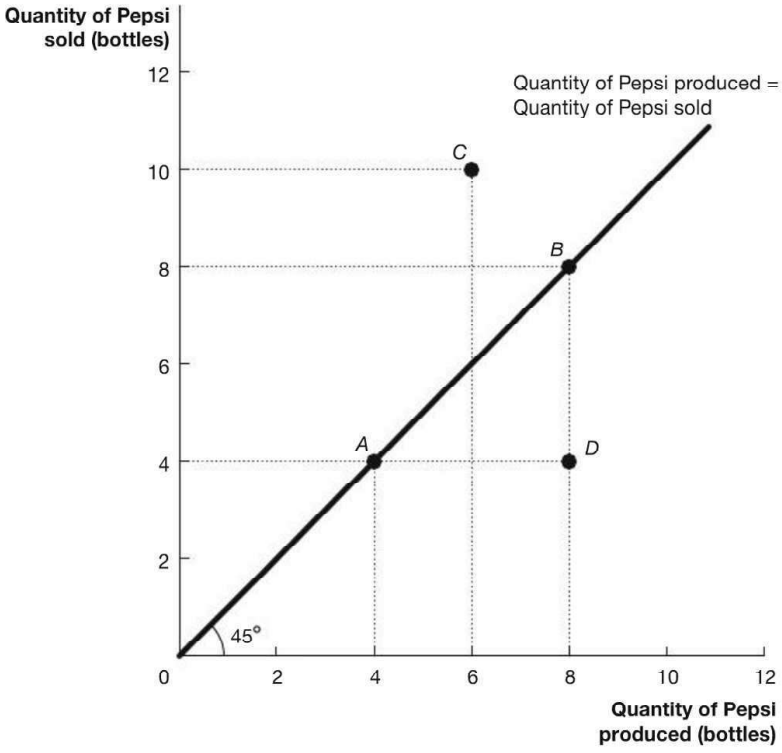

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Figure 12.8

An Example of a 45°-Line Diagram

The 45° line shows all the points that are equal distances from both axes. Points such as *A* and *B*, at which the quantity produced equals the quantity sold, are on the 45° line. Points such as *C*, at which the quantity sold is greater than the quantity produced, lie above the line. Points such as *D*, at which the quantity sold is less than the quantity produced, lie below the line.

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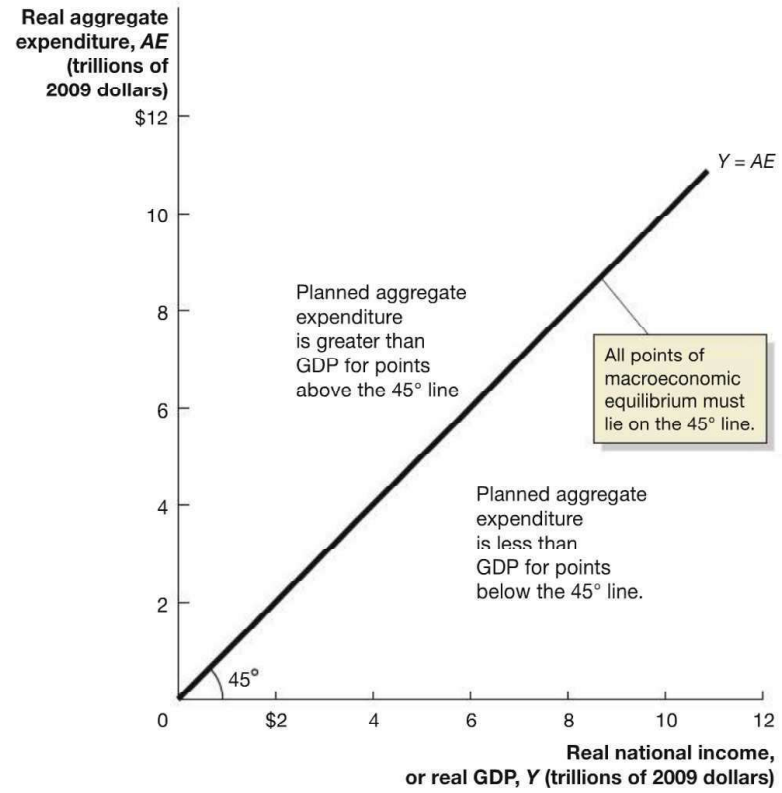
Figure 12.9

The Relationship between Planned Aggregate Expenditure and GDP on a 45°-Line Diagram

Every point of macroeconomic equilibrium is on the 45° line, where planned aggregate expenditure equals GDP. At points above the line, planned aggregate expenditure is greater than GDP. At points below the line, planned aggregate expenditure is less than GDP.



A and *B*, where the number of bottles of Pepsi produced equals the number of bottles sold, are on the 45° line. Points such as *C*, where the quantity sold is greater than the quantity produced, lie above the line. Points such as *D*, where the quantity sold is less than the quantity produced, lie below the line.

Figure 12.9 is similar to Figure 12.8 except that it measures real national income, or real GDP (*Y*), on the horizontal axis and planned real aggregate expenditure (*AE*) on the vertical axis. Because macroeconomic equilibrium occurs where planned aggregate expenditure equals GDP, *we know that all points of macroeconomic equilibrium must lie along the 45° line*. For all points above the 45° line, planned aggregate expenditure will be greater than GDP. For all points below the 45° line, planned aggregate expenditure will be less than GDP.

The 45° line shows many potential points of macroeconomic equilibrium. During any particular year, only one of these points will represent the actual level of equilibrium real GDP, given the actual level of planned real expenditure. To determine this point, we need to draw a line on the graph to represent the *aggregate expenditure function*, which shows the amount of planned aggregate expenditure that will occur at every level of national income, or GDP.

Changes in GDP have a much greater effect on consumption than on planned investment, government purchases, or net exports. For simplicity, we assume that changes in GDP have no effect on planned investment, government purchases, or net exports. We also assume that the other variables that determine planned investment, government purchases, and net exports all remain constant, as do the variables other than GDP that affect consumption. For example, we assume that a firm's level of planned investment at the beginning of the year will not change during the year, even if the level of GDP changes.

Figure 12.10 shows the aggregate expenditure function on the 45°-line diagram. The lowest upward-sloping line, *C*, represents the consumption function, as shown in Figure 12.2, panel (b), on page 396. The quantities of planned investment, government purchases, and net exports are constant because we assumed that the variables they depend on are constant. So, the level of planned aggregate expenditure at any

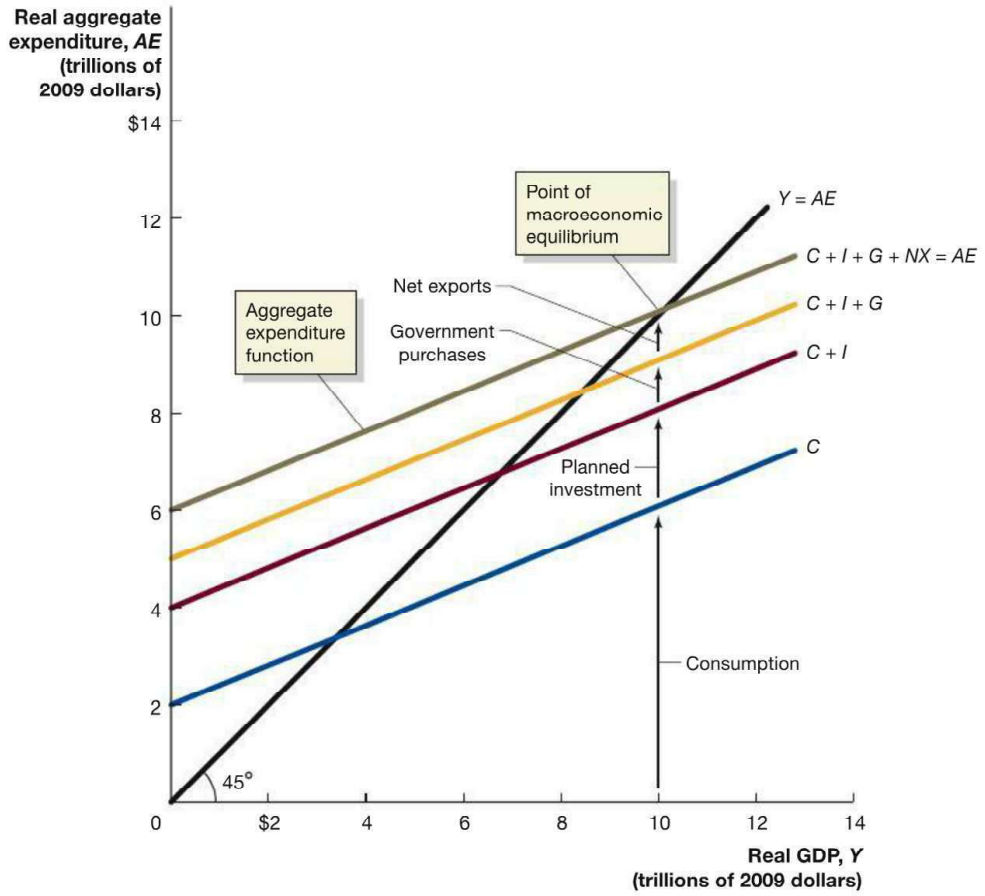


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Figure 12.10

Macroeconomic Equilibrium on the 45°-Line Diagram

Macroeconomic equilibrium occurs where the aggregate expenditure (*AE*) line crosses the 45° line. The lowest upward-sloping line, *C*, represents the consumption function. The quantities of planned investment, government purchases, and net exports are constant because we assumed that the variables they depend on are constant. So, the total of planned aggregate expenditure at any level of GDP is the amount of consumption at that level of GDP plus the sum of the constant amounts of planned investment, government purchases, and net exports. We successively add each component of spending to the consumption function line to arrive at the gray line representing aggregate expenditure.

level of GDP is the amount of consumption spending at that level of GDP plus the sum of the constant amounts of planned investment, government purchases, and net exports. In Figure 12.10, we add each component of spending successively to the consumption function line to arrive at the line representing planned aggregate expenditure (*AE*). The $C + I$ line is higher than the C line by the constant amount of planned investment; the $C + I + G$ line is higher than the $C + I$ line by the constant amount of government purchases; and the $C + I + G + NX$ line is higher than the $C + I + G$ line by the constant amount of NX. (In many years, however, NX is negative, which would cause the $C + I + G + NX$ line to be *below* the $C + I + G$ line.) The $C + I + G + NX$ line shows all four components of expenditure and is the aggregate expenditure (*AE*) function. At the point where the *AE* line crosses the 45° line, planned aggregate expenditure is equal to GDP, and the economy is in macroeconomic equilibrium.

Figure 12.11 makes the relationship between planned aggregate expenditure and GDP clearer by showing only the 45° line and the *AE* line. The figure shows that the *AE* line intersects the 45° line at a level of real GDP of $10 trillion. Therefore, $10 trillion represents the equilibrium level of real GDP. To see why, consider the situation if real GDP were only $8 trillion. By moving vertically from $8 trillion on the horizontal axis up to the *AE* line, we see that planned aggregate expenditure will be greater than $8 trillion at this level of real GDP. Whenever total spending is greater than total production, firms' inventories will fall. The fall in inventories is equal to the vertical distance between the *AE* line, which shows the level of total spending, and the 45° line, which shows the $8 trillion of total production. Unplanned declines in inventories lead firms to increase their production. As real GDP increases from $8 trillion, so will total income and, therefore, consumption. The economy will move up the *AE* line as consumption increases. The gap between total spending and total production will fall, but as long as the *AE* line is above the 45° line, inventories will continue to decline, and firms will

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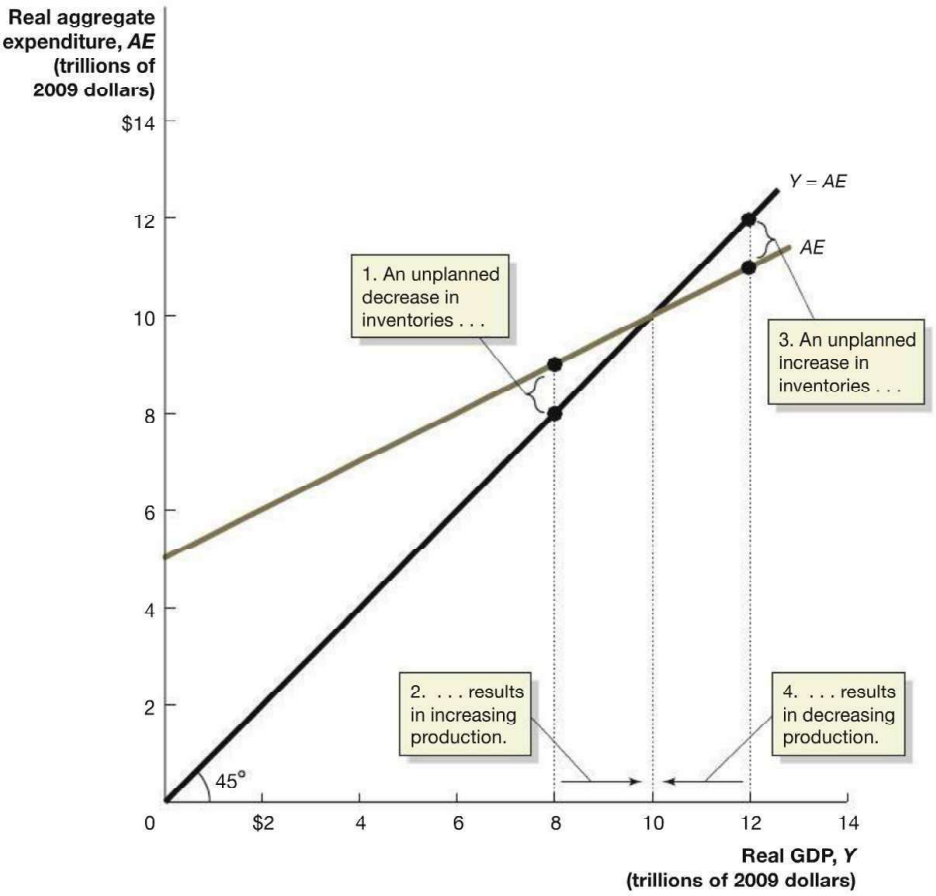
Figure 12.11

Macroeconomic Equilibrium

Macroeconomic equilibrium occurs where the *AE* line crosses the 45° line, which occurs at GDP of $10 trillion. If GDP is less than $10 trillion, the corresponding point on the *AE* line is above the 45° line, planned aggregate expenditure is greater than total production, firms will experience an unplanned decrease in inventories, and GDP will increase. If GDP is greater than $10 trillion, the corresponding point on the *AE* line is below the 45° line, planned aggregate expenditure is less than total production, firms will experience an unplanned increase in inventories, and GDP will decrease.



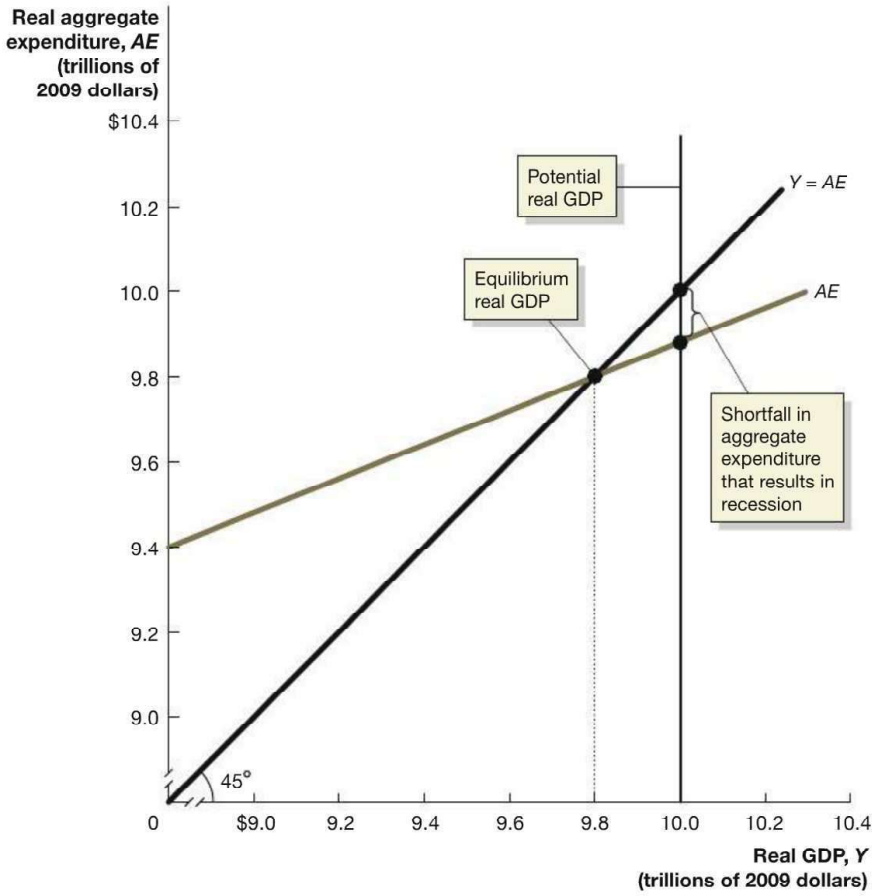
continue to expand production. When real GDP rises to $10 trillion, inventories stop falling, and the economy will be in macroeconomic equilibrium.

As Figure 12.11 shows, if GDP is initially $12 trillion, planned aggregate expenditure will be less than GDP, and firms will experience an unplanned increase in inventories. Rising inventories lead firms to decrease production. As GDP falls from $12 trillion, consumption will also fall, which causes the economy to move down the *AE* line. The gap between planned aggregate expenditure and GDP will fall, but as long as the *AE* line is below the 45° line, inventories will continue to rise, and firms will continue to cut production. When GDP falls to $10 trillion, inventories will stop rising, and the economy will be in macroeconomic equilibrium.

Showing a Recession on the 45°-Line Diagram

Notice that *macroeconomic equilibrium can occur at any point on the 45° line.* Ideally, equilibrium will occur at *potential GDP.* At potential GDP, firms will be operating at their normal level of capacity, and the economy will be at the *natural rate of unemployment.* As we have seen, at the natural rate of unemployment, the economy will be at *full employment*: Everyone in the labor force who wants a job will have one, except the structurally and frictionally unemployed (see Chapter 9). However, for equilibrium to occur at potential GDP, planned aggregate expenditure must be high enough. As Figure 12.12 shows, if there is insufficient total spending, equilibrium will occur at a lower level of real GDP. In this situation, many firms will be operating below their normal capacity, and the unemployment rate will be above the natural rate of unemployment.

Suppose that the level of potential GDP is $10 trillion. As Figure 12.12 shows, when GDP is $10 trillion, planned aggregate expenditure is below $10 trillion, perhaps because firms have become pessimistic about their future profitability and have reduced their investment spending. The shortfall in planned aggregate expenditure



MyEconLab Animation

Figure 12.12

Showing a Recession on the 45°-Line Diagram

When the aggregate expenditure line intersects the 45° line at a level of GDP below potential GDP, the economy is in recession. The figure shows that potential GDP is $10 trillion, but because planned aggregate expenditure is too low, the equilibrium level of GDP is only $9.8 trillion, where the *AE* line intersects the 45° line. As a result, some firms will be operating below their normal capacity, and unemployment will be above the natural rate of unemployment. We can measure the shortfall in planned aggregate expenditure as the vertical distance between the *AE* line and the 45° line at the level of potential GDP.

that leads to the recession can be measured as the vertical distance between the *AE* line and the 45° line at the level of potential GDP. The shortfall in planned aggregate expenditure is exactly equal to the unplanned increase in inventories that would occur if the economy were initially at a level of GDP of $10 trillion. The unplanned increase in inventories measures the amount by which current planned aggregate expenditure is too low for the current level of production to be the equilibrium level. Put another way, if any of the four components of aggregate expenditure increased by this amount, the *AE* line would shift upward and intersect the 45° line at GDP of $10 trillion, and the economy would be in macroeconomic equilibrium at full employment.

Figure 12.12 shows that macroeconomic equilibrium will occur when real GDP is $9.8 trillion. Because real GDP is 2 percent below potential GDP of $10 trillion, many firms will be operating below their normal capacity, and the unemployment rate will be well above the natural rate of unemployment. The economy will remain at this level of real GDP until there is an increase in one or more of the components of aggregate expenditure.

MyEconLab Concept Check

The Important Role of Inventories

Whenever planned aggregate expenditure is less than real GDP, some firms will experience unplanned increases in inventories. If firms do not cut back their production promptly when spending declines, they will accumulate inventories. If firms accumulate excess inventories, then even if spending quickly returns to its normal level, firms will have to sell their excess inventories before they can return to producing at normal levels. For example, more than half of the sharp 5.4 percent annual rate of decline in real GDP during the first quarter of 2009 resulted from firms cutting production as they sold off unintended accumulations of inventories.

MyEconLab Concept Check

Table 12.3 Macroeconomic Equilibrium

Real GDP (*Y*)	Consumption (*C*)	Planned Investment (*I*)	Government Purchases (*G*)	Net Exports (*NX*)	Planned Aggregate Expenditure (*AE*)	Unplanned Change in Inventories	Real GDP Will . . .
$8,000	$6,200	$1,500	$1,500	−$500	$8,700	−$700	increase
9,000	6,850	1,500	1,500	−500	9,350	−350	increase
10,000	7,500	1,500	1,500	−500	10,000	0	be in equilibrium
11,000	8,150	1,500	1,500	−500	10,650	+350	decrease
12,000	8,800	1,500	1,500	−500	11,300	+700	decrease

Note: The values are in billions of 2009 dollars.

A Numerical Example of Macroeconomic Equilibrium

In forecasting real GDP, economists rely on quantitative models of the economy. We can increase our understanding of the causes of changes in real GDP by considering a simple numerical example of macroeconomic equilibrium. Although simplified, this example captures some of the key features contained in the quantitative models that economic forecasters use. Table 12.3 shows several hypothetical combinations of real GDP and planned aggregate expenditure. The first column lists real GDP. The next four columns list levels of the four components of planned aggregate expenditure that occur at the corresponding level of real GDP. We assume that planned investment, government purchases, and net exports do not change as GDP changes. Because consumption depends on GDP, it increases as GDP increases.

Don't Let This Happen to You

Don't Confuse Aggregate Expenditure with Consumption Spending

Macroeconomic equilibrium occurs where planned aggregate expenditure equals GDP. But remember that planned aggregate expenditure equals the sum of consumption spending, planned investment spending, government purchases, and net exports, *not* consumption spending alone. If GDP were equal to consumption, the economy would not be in equilibrium. Planned investment plus government purchases plus net exports will always be a positive number. Therefore, if consumption were equal to GDP, aggregate expenditure would have to be greater than GDP. In that case, inventories would be decreasing, and GDP would be *increasing*; GDP would not be in equilibrium.

Test your understanding of macroeconomic equilibrium with this problem:

Question: Do you agree with the following argument?

> This chapter says macroeconomic equilibrium occurs where planned aggregate expenditure equals GDP. GDP is equal to national income. So, at equilibrium, planned aggregate expenditure must equal national income. But we know that consumers do not spend all of their income: They save at least some and use some to pay taxes. Therefore, aggregate expenditure will never equal national income, and the basic macroeconomic story is incorrect.

Answer: Remember that national income equals GDP (disregarding depreciation, as we have done throughout this chapter). So, it is correct to say that in macroeconomic equilibrium, planned aggregate expenditure must equal national income. But the last sentence of the argument is incorrect because it assumes that aggregate expenditure is the same as consumption spending. Because of saving and taxes, consumption spending is always much less than national income, but in equilibrium, the sum of consumption spending, planned investment spending, government purchases, and net exports does, in fact, equal GDP and national income. So, the argument is incorrect because it confuses consumption spending with aggregate expenditure.

MyEconLab Study Plan

Your Turn: Test your understanding by doing related problem 3.11 on page 427 at the end of this chapter.

In the first row of the table, GDP of $8,000 billion (or $8 trillion) results in consumption of $6,200 billion. Adding consumption, planned investment, government purchases, and net exports across the row gives planned aggregate expenditure of $8,700 billion, which is shown in the sixth column. Because planned aggregate expenditure is greater than GDP, inventories will fall by $700 billion. This unplanned decline in inventories will lead firms to increase production, and GDP will increase. GDP will continue to increase until it reaches $10,000 billion. At that level of GDP, planned aggregate expenditure is also $10,000 billion, unplanned changes in inventories are zero, and the economy is in macroeconomic equilibrium.

In the last row, GDP of $12,000 billion results in consumption of $8,800 billion and planned aggregate expenditure of $11,300 billion. Because planned aggregate expenditure is less than GDP, inventories will increase by $700 billion. This unplanned increase in inventories will lead firms to decrease production, and GDP will decrease. GDP will continue to decrease until it reaches $10,000 billion, unplanned changes in inventories are zero, and the economy is in macroeconomic equilibrium.

Only when real GDP equals $10,000 billion will the economy be in macroeconomic equilibrium. At other levels of real GDP, planned aggregate expenditure will be higher or lower than GDP, and the economy will be expanding or contracting. MyEconLab Concept Check

Solved Problem 12.3

MyEconLab Interactive Animation

Determining Macroeconomic Equilibrium

Fill in the blank cells in the following table and determine the equilibrium level of real GDP.

Real GDP (*Y*)	Consumption (*C*)	Planned Investment (*I*)	Government Purchases (*G*)	Net Exports (*NX*)	Planned Aggregate Expenditure (*AE*)	Unplanned Change in Inventories
$8,000	$6,200	$1,675	$1,675	−$500		
9,000	6,850	1,675	1,675	−500		
10,000	7,500	1,675	1,675	−500		
11,000	8,150	1,675	1,675	−500		
12,000	8,800	1,675	1,675	−500		

Solving the Problem

Step 1: **Review the chapter material.** This problem is about determining macroeconomic equilibrium, so you may want to review the section "A Numerical Example of Macroeconomic Equilibrium," which begins on page 412.

Step 2: **Fill in the missing values in the table.** We can calculate the missing values in the last two columns by using two equations:

$$\text{Planned aggregate expenditure } (AE) = \text{Consumption } (C) + \text{Planned investment } (I) + \text{Government purchases } (G) + \text{Net exports } (NX)$$

and:

$$\text{Unplanned change in inventories} = \text{Real GDP } (Y) - \text{Planned aggregate expenditure } (AE).$$

For example, to fill in the first row, we have AE = $6,200 billion + $1,675 billion + $1,675 billion + (−$500 billion) = $9,050 billion, and unplanned change in inventories = $8,000 billion − $9,050 billion = −$1,050 billion.

Real GDP (*Y*)	Consumption (*C*)	Planned Investment (*I*)	Government Purchases (*G*)	Net Exports (*NX*)	Planned Aggregate Expenditure (*AE*)	Unplanned Change in Inventories
$8,000	$6,200	$1,675	$1,675	−$500	$9,050	−1,050
9,000	6,850	1,675	1,675	−500	9,700	−700
10,000	7,500	1,675	1,675	−500	10,350	−350
11,000	8,150	1,675	1,675	−500	11,000	0
12,000	8,800	1,675	1,675	−500	11,650	350

Step 3: **Determine the equilibrium level of real GDP.** Once you fill in the table, you should see that equilibrium real GDP must be $11,000 billion because only at that level is real GDP equal to planned aggregate expenditure.

MyEconLab Study Plan

Your Turn: For more practice, do related problem 3.12 on page 427 at the end of this chapter.

12.4 The Multiplier Effect

LEARNING OBJECTIVE: Describe the multiplier effect and use the multiplier formula to calculate changes in equilibrium GDP.

So far, we have seen that aggregate expenditure determines real GDP in the short run, and we have seen how the economy adjusts if it is not in equilibrium. We have also seen that whenever aggregate expenditure changes, there will be a new level of equilibrium real GDP. In this section, we will look more closely at the effects of a change in aggregate expenditure on equilibrium real GDP. We begin the discussion with Figure 12.13, which illustrates the effect of an increase in planned investment spending. We assume that the economy starts in equilibrium at point *A*, at which real GDP is $9.6 trillion. Firms then become more optimistic about the future profitability of investment and increase spending on factories, machinery, and equipment by $100 billion. This increase in investment spending shifts the *AE* line up by

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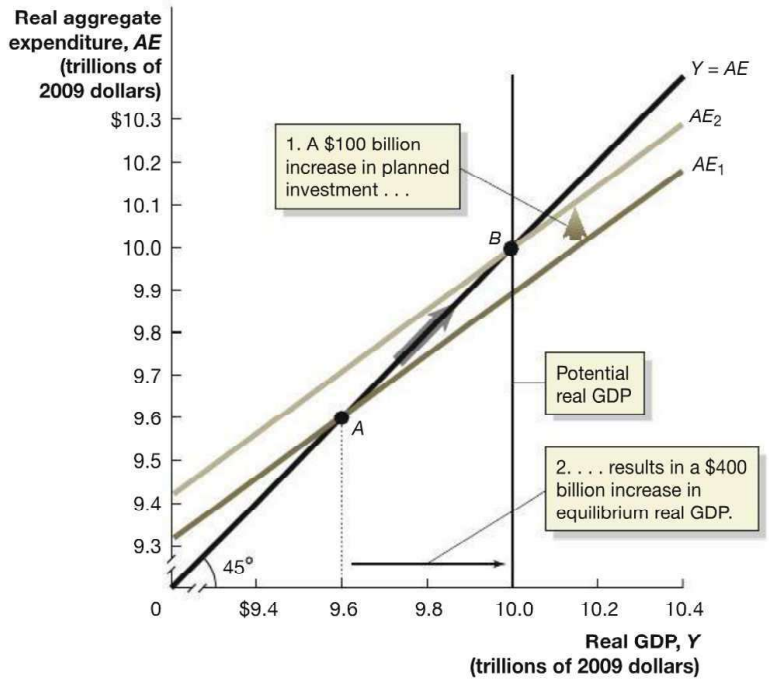
Figure 12.13

The Multiplier Effect

The economy begins at point *A*, at which equilibrium real GDP is $9.6 trillion. A $100 billion increase in planned investment shifts up aggregate expenditure from AE_1 to AE_2. The new equilibrium is at point *B*, where real GDP is $10.0 trillion, which is potential real GDP. Because of the multiplier effect, a $100 billion increase in investment results in a $400 billion increase in equilibrium real GDP.



$100 billion, from AE_1 to AE_2. The new equilibrium occurs at point *B*, at which real GDP is $10.0 trillion, which equals potential real GDP.

Notice that the initial $100 billion increase in planned investment spending results in a $400 billion increase in equilibrium real GDP. The increase in planned investment spending has had a *multiplied effect* on equilibrium real GDP. It is not only investment spending that will have this multiplied effect; any increase in *autonomous expenditure* will shift up the aggregate expenditure function and lead to a multiplied increase in equilibrium GDP. **Autonomous expenditure** does not depend on the level of GDP. In the aggregate expenditure model we have been using, planned investment spending, government spending, and net exports are all autonomous expenditures. Consumption has both an autonomous component, which does not depend on the level of GDP, and a nonautonomous—or *induced*—component, which does depend on the level of GDP. For example, if households decide to spend more of their incomes—and save less—at every level of income, there will be an autonomous increase in consumption spending, and the aggregate expenditure function will shift up. If, however, real GDP increases and households increase their consumption spending, as indicated by the consumption function, there will be a movement up along the aggregate expenditure function, and the increase in consumption spending will be nonautonomous.

Autonomous expenditure An expenditure that does not depend on the level of GDP.

The ratio of the increase in equilibrium real GDP to the increase in autonomous expenditure is called the **multiplier**. The series of induced increases in consumption spending that results from an initial increase in autonomous expenditure is called the **multiplier effect**. The multiplier effect occurs because an initial increase in autonomous expenditure sets off a series of increases in real GDP.

Multiplier The increase in equilibrium real GDP divided by the increase in autonomous expenditure.

Multiplier effect The process by which an increase in autonomous expenditure leads to a larger increase in real GDP.

We can look more closely at the multiplier effect. Suppose the whole $100 billion increase in investment spending shown in Figure 12.13 consists of firms building additional factories and office buildings. Initially, this additional spending will cause the construction of factories and office buildings to increase by $100 billion, so GDP will also increase by $100 billion. Remember that increases in production result in equal increases in national income. So, this increase in real GDP of $100 billion is also an increase in national income of $100 billion. In this example, the income is received as wages and salaries by the employees of the construction firms, as profit by the owners of the firms, and so on. After receiving this additional income, these workers, managers, and owners will increase their consumption of cars, appliances, furniture, and many other products. If the marginal propensity to consume (*MPC*) is 0.75, we know the increase in consumption spending will be $75 billion. This additional $75 billion in spending will cause the firms making the cars, appliances, and other products to increase production by $75 billion, so GDP will rise by $75 billion. This increase in GDP means national income has also increased by another $75 billion. This increased income will be received by the owners and employees of the firms producing the cars, appliances, and other products. These workers, managers, and owners in turn will increase their consumption spending, and the process of increasing production, income, and consumption will continue.

Eventually, the total increase in consumption will be $300 billion. (We will soon show how we determined this value.) The $300 billion increase in consumption combined with the initial $100 billion increase in investment spending will result in a total change in equilibrium GDP of $400 billion. Table 12.4 summarizes how changes in GDP and spending caused by the initial $100 billion increase in investment will result in equilibrium GDP rising by $400 billion. We can think of the multiplier effect occurring in rounds of spending. In round 1, there is an increase of $100 billion in autonomous expenditure—the $100 billion in planned investment spending in our example—which causes GDP to rise by $100 billion. In round 2, induced expenditure rises by $75 billion (which equals the $100 billion increase in real GDP in round 1 multiplied by the *MPC*). The $75 billion in induced expenditure in round 2 causes a $75 billion increase in real GDP, which leads to a $56 billion increase in induced expenditure in round 3, and so on. The final column adds up the total increases in expenditure, which equal the total increase in GDP. In each round, the additional induced

Table 12.4

The Multiplier Effect in Action

	Additional Autonomous Expenditure (investment)	Additional Induced Expenditure (consumption)	Total Additional Expenditure = Total Additional GDP
Round 1	$100 billion	$0	$100 billion
Round 2	0	75 billion	175 billion
Round 3	0	56 billion	231 billion
Round 4	0	42 billion	273 billion
Round 5	0	32 billion	305 billion
.	.	.	.
.	.	.	.
.	.	.	.
Round 10	0	8 billion	377 billion
.	.	.	.
.	.	.	.
.	.	.	.
Round 15	0	2 billion	395 billion
.	.	.	.
.	.	.	.
.	.	.	.
Round 19	0	1 billion	398 billion
.	.	.	.
.	.	.	.
.	.	.	.
Round *n*	0	0	400 billion

expenditure becomes smaller because the *MPC* is less than 1. By round 10, additional induced expenditure is only $8 billion, and the total increase in GDP from the beginning of the process is $377 billion. By round 19, the process is almost complete: Additional induced expenditure is only about $1 billion, and the total increase in GDP is $398 billion. Eventually, the process will be finished, although we cannot say precisely how many spending rounds it will take, so we simply label the last round *n* rather than give it a specific number.

We can calculate the value of the multiplier in our example by dividing the increase in equilibrium real GDP by the increase in autonomous expenditure:

$$\frac{\Delta Y}{\Delta I} = \frac{\text{Change in real GDP}}{\text{Change in investment spending}} = \frac{\$400 \text{ billion}}{\$100 \text{ billion}} = 4.$$

With a multiplier of 4, each increase in autonomous expenditure of $1 will result in an increase in equilibrium GDP of $4.

Making the Connection

MyEconLab Video

The Multiplier in Reverse: The Great Depression of the 1930s

An increase in autonomous expenditure causes an increase in equilibrium real GDP, but the reverse is also true: A decrease in autonomous expenditure causes a decrease in real GDP. Many Americans became aware of this fact in the 1930s, when reductions in autonomous expenditure were magnified by the multiplier into the largest decline in real GDP in U.S. history.

In August 1929, the economy reached a business cycle peak, and a downturn in production began. In October, the stock market crashed, destroying billions of dollars of wealth and increasing pessimism among households and firms. Both consumption spending and planned investment spending declined. The passage by the U.S. Congress of the Smoot-Hawley Tariff Act in June 1930 helped set off a trade war that reduced exports. A series of banking crises that began in the fall of 1930 limited the ability of households and firms to finance consumption and investment. As aggregate expenditure declined, many firms experienced declining sales and began to lay off workers. Falling levels of production and income induced further declines in consumption spending, which led to further cutbacks in production and employment, leading to further declines in income, and so on, in a downward spiral. The following table shows the severity of the economic downturn by contrasting the business cycle peak of 1929 with the business cycle trough of 1933:

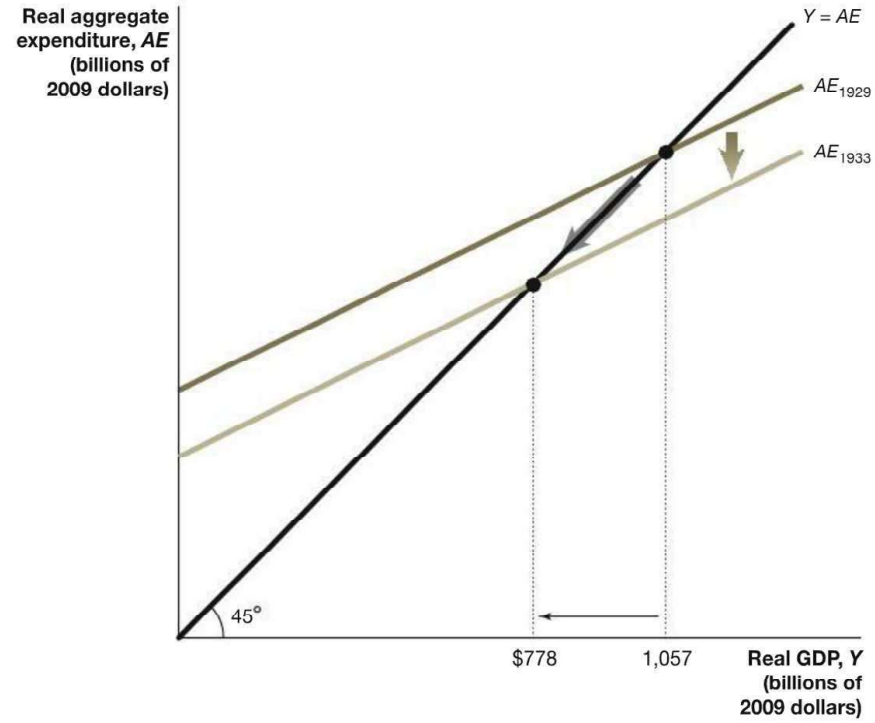
The multiplier effect contributed to the very high levels of unemployment during the Great Depression.

Year	Consumption	Investment	Exports	Real GDP	Unemployment Rate
1929	$781 billion	$124 billion	$41 billion	$1,057 billion	2.9%
1933	$638 billion	$27 billion	$22 billion	$778 billion	20.9%

Note: The values are in 2009 dollars.

Sources: U.S. Bureau of Economic Analysis; and David R. Weir, "A Century of U.S. Unemployment, 1890–1990," in Roger L. Ransom, Richard Sutch, and Susan B. Carter, eds., *Research in Economic History*, Vol. 14, San Diego, CA: JAI Press, 1992, Table D3, pp. 341–343.

We can use a 45°-line diagram to illustrate the multiplier effect working in reverse during these years. The economy was at potential real GDP in 1929, before the declines in aggregate expenditure began. Declining consumption, planned investment, and net exports shifted the aggregate expenditure function down from AE_{1929} to AE_{1933}, reducing equilibrium real GDP from $1,057 billion in 1929 to $778 billion in 1933. The depth and length of this economic downturn led to its being labeled the Great Depression.



The severity of the Great Depression forced thousands of firms to declare bankruptcy. Even firms that survived experienced sharp declines in sales. By 1933, production at U.S. Steel had declined 90 percent, and production at General Motors had declined more than 75 percent. High rates of unemployment forced many families into poverty and a daily struggle for survival. Recovery from the business cycle trough in 1933 was slow. Real GDP did not regain its 1929 level until 1936, and a growing labor force meant that the unemployment rate did not return to its 1929 level until 1942, after the United States entered World War II.

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Your Turn: Test your understanding by doing related problem 4.6 on page 428 at the end of this chapter.

A Formula for the Multiplier

Table 12.4 on page 416 shows that during the multiplier process, each round of increases in consumption is smaller than in the previous round, so eventually, the increases will come to an end, and we will have a new macroeconomic equilibrium. But how do we know that when we add all the increases in GDP, the total will be $400 billion? We can verify this result by first writing out the total change in equilibrium GDP:

The total change in equilibrium real GDP equals the initial increase in planned investment spending $= 100$ billion

Plus the first induced increase in consumption $= MPC \times \$100$ billion

Plus the second induced increase in consumption $= MPC \times (MPC \times \$100 \text{ billion})$
$= MPC^2 \times \$100$ billion

Plus the third induced increase in consumption $= MPC \times (MPC^2 \times \$100 \text{ billion})$
$= MPC^3 \times \$100$ billion

Plus the fourth induced increase in consumption $= MPC \times (MPC^3 \times \$100 \text{ billion})$
$= MPC^4 \times \$100$ billion

and so on …

Or:

$$\text{Total change in GDP} = \$100 \text{ billion} + (MPC \times \$100 \text{ billion}) + (MPC^2 \times \$100 \text{ billion}) + (MPC^3 \times \$100 \text{ billion}) + (MPC^4 \times \$100 \text{ billion}) + \ldots$$

where the ellipsis (…) indicates that the expression contains an infinite number of similar terms.

If we factor out the $100 billion from each expression, we have:

$$\text{Total change in GDP} = \$100 \text{ billion} \times (1 + MPC + MPC^2 + MPC^3 + MPC^4 + \ldots)$$

Mathematicians have shown that an expression like the one in the parentheses sums to:

$$\frac{1}{1 - MPC}.$$

In this case, the *MPC* is equal to 0.75. So, we can now calculate that the change in equilibrium GDP $= \$100$ billion $\times [1/(1 - 0.75)] = \$100$ billion $\times 4 = \$400$ billion, as shown in Table 12.4. We have also derived a general formula for the multiplier:

$$\text{Multiplier} = \frac{\text{Change in equilibrium real GDP}}{\text{Change in autonomous expenditure}} = \frac{1}{1 - MPC}.$$

In this case, the multiplier is $1/(1 - 0.75)$, or 4, which means that for each additional $1 of autonomous spending, equilibrium GDP will increase by $4. A $100 billion increase in planned investment spending results in a $400 billion increase in equilibrium GDP.

Notice that the value of the multiplier depends on the value of the *MPC*. In particular, the larger the value of the *MPC*, the larger the value of the multiplier. For example, if the *MPC* were 0.9 instead of 0.75, the value of the multiplier would increase from 4 to $1/(1 - 0.9) = 10$. MyEconLab Concept Check

Summarizing the Multiplier Effect

You should note four key points about the multiplier effect:

1. The multiplier effect occurs both when autonomous expenditure increases and when it decreases. For example, with an *MPC* of 0.75, a *decrease* in planned investment of $100 billion will lead to a *decrease* in equilibrium income of $400 billion.
2. The multiplier effect makes the economy more sensitive to changes in autonomous expenditure than it would otherwise be. Between the fourth quarter of 2005 and the second quarter of 2009, spending on residential construction declined by 57 percent. This decline in investment set off a series of declines in production, income, and spending so that firms such as automobile dealerships and clothing stores, which are far removed from the housing industry, also experienced declines in sales. Because of the multiplier effect, a decline in spending and production in one sector of the economy can lead to declines in spending and production in many other sectors of the economy.
3. The larger the *MPC*, the larger the value of the multiplier. With an *MPC* of 0.75, the multiplier is 4, but with an *MPC* of 0.50, the multiplier is only 2. This direct relationship between the value of the *MPC* and the value of the multiplier holds true because the larger the *MPC*, the larger the change in consumption that takes place after each change in income during the multiplier process.
4. The formula for the multiplier, $1/(1 - MPC)$, is oversimplified because it ignores some real-world complications, such as the effect that increases in GDP have on imports, inflation, interest rates, and individual income taxes. These effects combine to cause the simple formula to overstate the true value of the multiplier. Beginning in Chapter 13, we will start to take into account these real-world complications. MyEconLab Concept Check

Solved Problem 12.4

MyEconLab Interactive Animation

Using the Multiplier Formula

Use the information in the table to answer the following questions:

Real GDP (*Y*)	Consumption (*C*)	Planned Investment (*I*)	Government Purchases (*G*)	Net Exports (*NX*)
$8,000	$6,900	$1,000	$1,000	−$500
9,000	7,700	1,000	1,000	−500
10,000	8,500	1,000	1,000	−500
11,000	9,300	1,000	1,000	−500
12,000	10,100	1,000	1,000	−500

Note: The values are in billions of 2009 dollars.

a. What is the equilibrium level of real GDP?

b. What is the *MPC*?

c. Suppose government purchases increase by $200 billion. What will be the new equilibrium level of real GDP? Use the multiplier formula to determine your answer.

Solving the Problem

Step 1: **Review the chapter material.** This problem is about the multiplier process, so you may want to review the section "The Multiplier Effect," which begins on page 414.

Step 2: **Answer part (a) by determining equilibrium real GDP.** Just as in Solved Problem 12.2 on page 399, we can find macroeconomic equilibrium by

calculating the level of planned aggregate expenditure for each level of real GDP:

Real GDP (*Y*)	Consumption (*C*)	Planned Investment (*I*)	Government Purchases (*G*)	Net Exports (*NX*)	Planned Aggregate Expenditure (*AE*)
$8,000	$6,900	$1,000	$1,000	−$500	$8,400
9,000	7,700	1,000	1,000	−500	9,200
10,000	8,500	1,000	1,000	−500	10,000
11,000	9,300	1,000	1,000	−500	10,800
12,000	10,100	1,000	1,000	−500	11,600

We can see that macroeconomic equilibrium will occur when real GDP equals $10,000 billion.

Step 3: **Answer part (b) by calculating the *MPC*.**

$$MPC = \frac{\Delta C}{\Delta Y}.$$

In this case:

$$MPC = \frac{\$800 \text{ billion}}{\$1{,}000 \text{ billion}} = 0.8.$$

Step 4: **Answer part (c) by using the multiplier formula to calculate the new equilibrium level of real GDP.** We could find the new level of equilibrium real GDP by constructing a new table with government purchases increased from $1,000 to $1,200. But the multiplier allows us to calculate the answer directly. In this case:

$$\text{Multiplier} = \frac{1}{1 - MPC} = \frac{1}{1 - 0.8} = 5.$$

So:

Change in equilibrium real GDP = Change in autonomous expenditure × 5.

Or:

Change in equilibrium real GDP = $200 billion × 5 = $1,000 billion.

Therefore:

$$\begin{aligned}\text{New level of equilibrium GDP} &= \$10{,}000 \text{ billion} + \$1{,}000 \text{ billion} \\ &= \$11{,}000 \text{ billion}.\end{aligned}$$

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Your Turn: For more practice, do related problem 4.7 on page 428 at the end of this chapter.

The Paradox of Thrift

We have seen that an increase in saving can increase the rate of economic growth in the long run by providing funds for investment (see Chapters 9 and 10). But in the short run, if households save more of their income and spend less of it, aggregate expenditure and real GDP will decline. In discussing the aggregate expenditure model, John Maynard Keynes argued that if many households decide at the same time to increase their saving and reduce their spending, they may make themselves worse off by causing aggregate expenditure to fall, thereby pushing the economy into a recession. The lower incomes in the recession might mean that total saving does not increase, despite the attempts by many individuals to increase their own saving. Keynes called this outcome the *paradox of thrift* because what appears to be something

favorable to the long-run performance of the economy might be counterproductive in the short run.

Households saved very little of their income in the mid-2000s but increased their saving markedly in late 2008 and 2009. The personal saving rate is saving by households as a percentage of disposable personal income. By mid-2009, the personal saving rate had increased to 6 percent. Some economists argued that this increase in saving contributed to the recession and weak recovery by reducing consumption spending. Other economists are skeptical of the reasoning behind the paradox of thrift. An increase in saving, by increasing the supply of loanable funds, should lower the real interest rate and increase the level of investment spending (see Chapter 10). This increase in investment spending might offset some or all of the decline in consumption spending attributable to increased saving. Economists continue to debate the short-run effects of an increase in saving.

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12.5 The Aggregate Demand Curve

LEARNING OBJECTIVE: Understand the relationship between the aggregate demand curve and aggregate expenditure.

When demand for a product increases, firms usually respond by increasing production, but they are also likely to increase prices. Similarly, when demand falls, production falls, but prices may also fall. We would expect, then, that an increase or a decrease in aggregate expenditure would affect not just real GDP but also the *price level*. Will a change in the price level, in turn, affect the components of aggregate expenditure? In fact, as we will see, increases in the price level cause aggregate expenditure to fall, and decreases in the price level cause aggregate expenditure to rise. There are three main reasons for this inverse relationship between changes in the price level and changes in aggregate expenditure. We discussed the first two reasons in Section 12.2 when considering the factors that determine consumption and net exports:

1. A rising price level decreases consumption by decreasing the real value of household wealth; a falling price level has the reverse effect.
2. If the price level in the United States rises relative to the price levels in other countries, U.S. exports will become relatively more expensive, and foreign imports will become relatively less expensive, causing net exports to fall. A falling price level in the United States has the reverse effect.
3. When prices rise, firms and households need more money to finance buying and selling. If the central bank (the Federal Reserve in the United States) does not increase the money supply, the result will be an increase in the interest rate. In Chapter 14, we will analyze in more detail why the interest rate increases. As we discussed in Section 12.2, at a higher interest rate, investment spending falls as firms borrow less money to build new factories or to install new machinery and equipment and households borrow less money to buy new houses. A falling price level has the reverse effect: Other things being equal, interest rates will fall, and investment spending will rise.

We can now incorporate the effect of a change in the price level into the basic aggregate expenditure model, in which equilibrium real GDP is determined by the intersection of the aggregate expenditure (*AE*) line and the 45° line. Remember that we measure the price level as an index number with a value of 100 in the base year. If the price level rises from, say, 100 to 103, consumption, planned investment, and net exports will all fall, causing the *AE* line to shift down in the 45°-line diagram. The *AE* line shifts down because with higher prices, less spending will occur in the economy at every level of GDP. Panel (a) of Figure 12.14 shows that the downward shift of the *AE* line results in a lower level of equilibrium real GDP.

If the price level falls from, say, 100 to 97, then investment, consumption, and net exports will all rise. As panel (b) of Figure 12.14 shows, the *AE* line will shift up, which will cause equilibrium real GDP to increase.

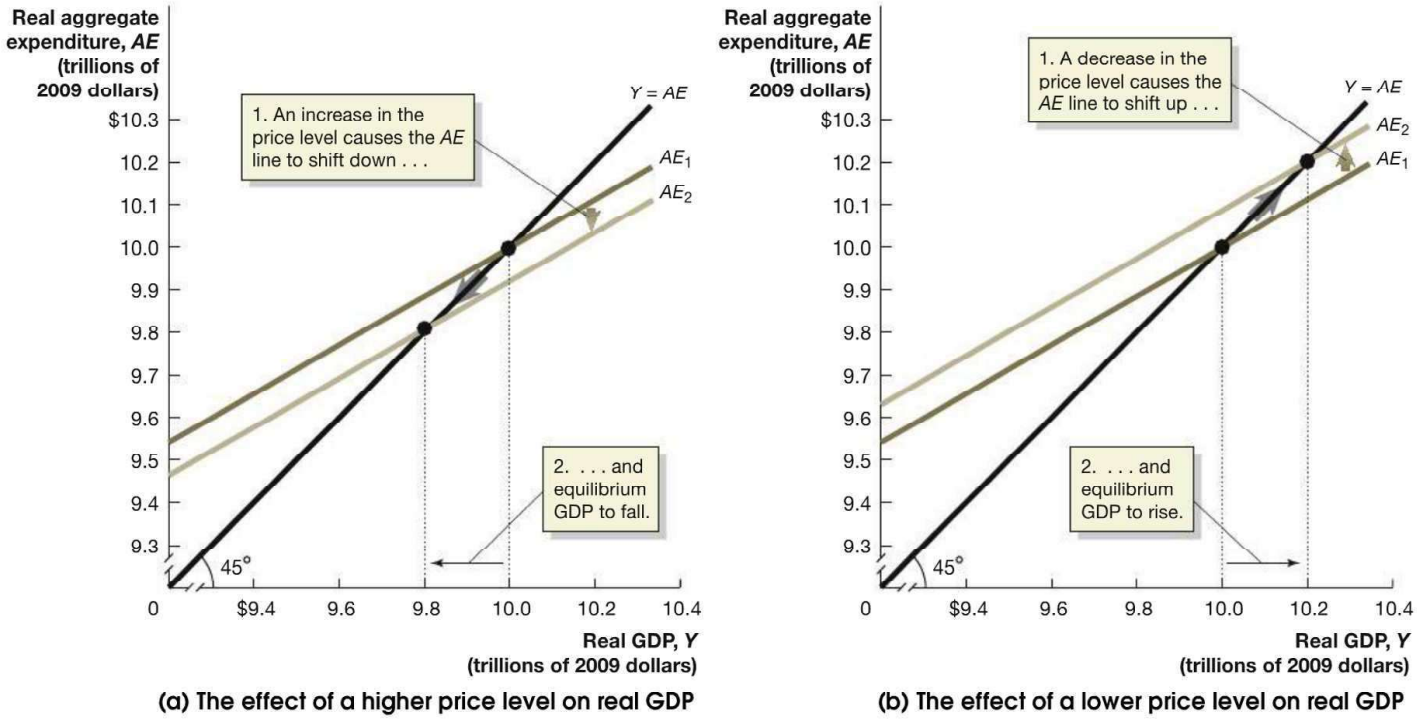

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Figure 12.14 The Effect of a Change in the Price Level on Real GDP

In panel (a), an increase in the price level results in declining consumption, planned investment, and net exports and causes the aggregate expenditure line to shift down from AE_1 to AE_2. As a result, equilibrium real GDP declines from $10.0 trillion to $9.8 trillion.

In panel (b), a decrease in the price level results in rising consumption, planned investment, and net exports and causes the aggregate expenditure line to shift up from AE_1 to AE_2. As a result, equilibrium real GDP increases from $10.0 trillion to $10.2 trillion.

Aggregate demand (*AD*) curve
A curve that shows the relationship between the price level and the level of planned aggregate expenditure in the economy, holding constant all other factors that affect aggregate expenditure.

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Figure 12.15 summarizes the effect of changes in the price level on real GDP. The table shows the combinations of price level and real GDP from Figure 12.14. The graph plots the numbers from the table. In the graph, the price level is measured on the vertical axis, and real GDP is measured on the horizontal axis. The relationship shown in Figure 12.15 between the price level and the level of planned aggregate expenditure is known as the **aggregate demand (*AD*) curve**.

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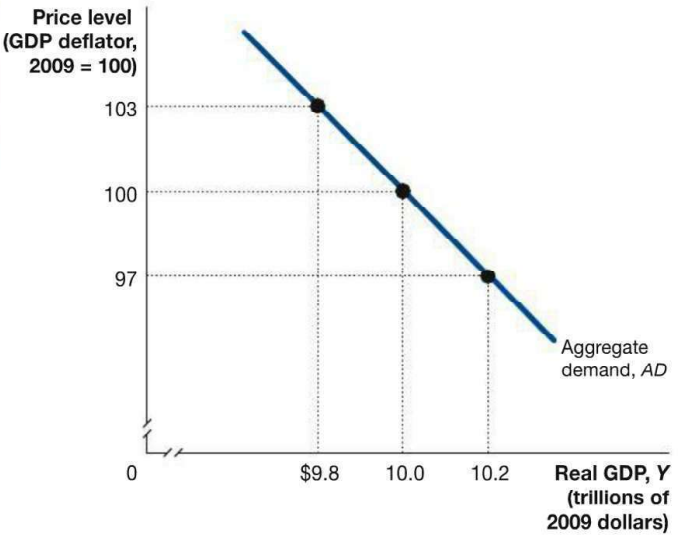
Figure 12.15

The Aggregate Demand Curve

The aggregate demand (*AD*) curve shows the relationship between the price level and the level of planned aggregate expenditure in the economy. When the price level is 97, real GDP is $10.2 trillion. An increase in the price level to 100 causes consumption, investment, and net exports to fall, which reduces real GDP to $10.0 trillion.

Price level	Equilibrium real GDP
97	$10.2 trillion
100	10.0 trillion
103	9.8 trillion



Continued from page 389

Economics in Your Life

When Consumer Confidence Falls, Is Your Job at Risk?

At the beginning of this chapter, we asked you to suppose that you work part time for a company that manufacturers door handles for automobiles. You have learned that consumer confidence in the economy has fallen and that many households expect their future income to be well below their current income. Should you be concerned about losing your job? We have seen in this chapter that if consumers expect their future income to decline, they will cut their consumption spending, and consumption spending is more than two-thirds of aggregate expenditure. So, if the decline in consumer confidence is correctly forecasting a decline in consumption spending, then aggregate expenditure and GDP will also likely decline. In deciding how likely your company is to lay you off, you should consider the following factors: If the economy moves into a recession, spending on automobiles by households and firms is likely to fall, which could reduce your firm's sales and possibly cost you a job. Before you panic, though, keep in mind that surveys of consumer confidence do not have a good track record in predicting recessions, so you may not have to move back in with your parents after all.

Conclusion

In this chapter, we examined a key macroeconomic idea: In the short run, the level of GDP is determined mainly by the level of aggregate expenditure. When economists forecast changes in GDP, they do so by forecasting changes in the four components of aggregate expenditure. We constructed an aggregate demand curve by taking into account how changes in the price level affect aggregate expenditure.

But our story is incomplete. In Chapter 13, we will analyze the *aggregate supply curve*. Then we will use the aggregate demand curve and the aggregate supply curve to show how equilibrium real GDP and the equilibrium price level are simultaneously determined.

We also need to discuss the roles that the financial system and government policy play in determining real GDP and the price level in the short run. We will cover these important topics in the following chapters.

Visit MyEconLab for a news article and analysis related to the concepts in this chapter.

CHAPTER SUMMARY AND PROBLEMS

Key Terms

Aggregate demand (*AD*) curve, p. 422
Aggregate expenditure (*AE*), p. 390
Aggregate expenditure model, p. 390
Autonomous expenditure, p. 415
Cash flow, p. 401
Consumption function, p. 395
Inventories, p. 391
Marginal propensity to consume (*MPC*), p. 396
Marginal propensity to save (*MPS*), p. 398
Multiplier, p. 415
Multiplier effect, p. 415

12.1 The Aggregate Expenditure Model, pages 390–393

LEARNING OBJECTIVE: Understand how macroeconomic equilibrium is determined in the aggregate expenditure model.

Summary

Aggregate expenditure (*AE*) is the total amount of spending in the economy. The **aggregate expenditure model** focuses on the relationship between total spending and real GDP in the short run, assuming that the price level is constant. In any particular year, the level of GDP is determined by the level of total spending, or aggregate expenditure, in the economy. The four components of aggregate expenditure are consumption (*C*), planned investment (*I*), government purchases (*G*), and net exports (*NX*). When aggregate expenditure is greater than GDP, there is an unplanned decrease in **inventories**, which are goods that have been produced but not yet sold, and GDP and total employment will increase. When aggregate expenditure is less than GDP, there is an unplanned increase in inventories, and GDP and total employment will decline. When aggregate expenditure is equal to GDP, firms will sell what they expected to sell, production and employment will be unchanged, and the economy will be in macroeconomic equilibrium.

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Review Questions

1.1 What is the key idea in the aggregate expenditure macroeconomic model?

1.2 What are inventories? What usually happens to inventories at the beginning of a recession? At the beginning of an expansion?

1.3 Which of the following does the aggregate expenditure model seek to explain: long-run economic growth, the business cycle, inflation, or cyclical unemployment?

Problems and Applications

1.4 Into which category of aggregate expenditure would each of the following transactions fall?

a. The Jones family buys a new car.
b. The San Diego Unified School District buys 12 new school buses.
c. The Jones family buys a newly constructed house from the Garcia Construction Co.
d. Joe Jones orders a Burberry coat from an online site in the United Kingdom.
e. Prudential insurance company purchases 250 new iPads from Apple.

1.5 Assume that Intel sells $1 billion of computer chips to Dell, Inc., for use in Dell's personal computers. How does this transaction affect aggregate expenditure?

1.6 In reporting on real GDP growth in the second quarter of 2015, an article in the *Wall Street Journal* noted that the 2.3 percent annual growth rate "would have been stronger if it hadn't been for companies drawing down inventories."

a. If companies are "drawing down inventories," is aggregate expenditure likely to have been larger or smaller than GDP?
b. Assume that the reduction in inventories was unplanned. What would you expect to happen to production in the future following an unplanned reduction in inventories?

Source: Justin Lahart, "Consumers Priming U.S. Pump," *Wall Street Journal*, July 30, 2015.

1.7 In the third quarter of 2015, business inventories in the United States increased by $62 billion. Can we tell from this information whether aggregate expenditure was higher or lower than GDP during the third quarter of 2015? If not, what other information do we need?

Source: Bureau of Economic Analysis.

1.8 An article in the *Wall Street Journal* stated that in China, "carmakers continue to grapple with … rising inventories." Why might carmakers in China find that their inventories are unexpectedly rising? How are these carmakers likely to react to the increase in inventories?

Source: Colum Murphy, "China's Automobile Sales to Slow Further in 2015," *Wall Street Journal*, January 12, 2015.

1.9 According to an article in the *Wall Street Journal*, in late 2014, the Japanese economy experienced a large increase in business inventories. The article noted, "The large buildup of inventories is a reflection that the … drop in demand was bigger than expected." Does it matter that Japanese firms didn't expect the drop in demand? Won't a decline in demand always lead to an increase in firms' holdings of inventories? Briefly explain.

Source: Eleanor Warnock, "Rising Inventories Hamper Japan Recovery," *Wall Street Journal*, September 30, 2014.

12.2 Determining the Level of Aggregate Expenditure in the Economy, pages 393–407

LEARNING OBJECTIVE: Discuss the determinants of the four components of aggregate expenditure and define marginal propensity to consume and marginal propensity to save.

Summary

The five determinants of consumption are current disposable income, household wealth, expected future income, the price level, and the interest rate. The **consumption function** is the relationship between consumption and disposable income. The **marginal propensity to consume (*MPC*)** is the change in consumption divided by the change in disposable income. The **marginal propensity to save (*MPS*)** is the change in saving divided by the change in disposable income. The determinants of planned investment are expectations of future profitability, the real interest rate, taxes, and **cash flow**, which is the difference between the cash revenues received by a firm and the cash spending by the firm. Government purchases include spending by the federal government and by local and state governments for goods and services. Government purchases do not include *transfer payments*, such as Social Security payments by the federal government or pension payments by local governments to retired police officers and firefighters. The three determinants of net exports are changes in the price level in the United States relative to changes in the price levels in other countries, the growth rate of GDP in the United States relative to the growth rates of GDP in other countries, and the exchange rate between the dollar and other currencies.

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Review Questions

2.1 In the aggregate expenditure model, why is it important to know the factors that determine consumption spending, investment spending, government purchases, and net exports?

2.2 What are the five main determinants of consumption spending? Which of these is the most important? How would a rise in stock prices or housing prices affect consumption spending?

2.3 Compare what happened to real investment between 1979 and the second quarter of 2015 with what happened to real consumption during that period.

2.4 What are the four main determinants of investment? How would a change in interest rates affect investment?

2.5 What are the three main determinants of net exports? How would an increase in the growth rate of GDP in the BRIC nations (Brazil, Russia, India, and China) affect U.S. net exports?

Problems and Applications

2.6 **(Related to the Chapter Opener on page 389)** Suppose a major U.S. appliance manufacturer is forecasting demand for its products during the next year. How will the forecast be affected by each of the following?

a. A survey shows a sharp rise in consumer confidence that income growth will be increasing.
b. Real interest rates are expected to increase.
c. The value of the U.S. dollar is expected to increase versus foreign currencies.
d. Planned investment spending in the economy is expected to decrease.

2.7 Draw the consumption function and label each axis. Show the effect of an increase in income on consumption spending. Does the change in income cause a movement along the consumption function or a shift of the consumption function? How would an increase in expected future income or an increase in household wealth affect the consumption function? Would these increases cause a movement along the consumption function or a shift of the consumption function? Briefly explain.

2.8 An economics student raises the following objection: "The textbook said that a higher interest rate lowers investment, but this doesn't make sense. I know that if I can get a higher interest rate, I am certainly going to invest more in my savings account." Briefly explain whether you agree with this reasoning.

2.9 Unemployed workers receive unemployment insurance payments from the government. Does the existence of unemployment insurance make it likely that consumption will fluctuate more or less over the business cycle than it would in the absence of unemployment insurance? Briefly explain.

2.10 **(Related to Solved Problem 12.2 on page 399)** Fill in the blank cells in the following table. Assume for simplicity that taxes are zero. Also assume that the values represent billions of 2009 dollars.

National Income and Real GDP (*Y*)	Consumption (*C*)	Saving (*S*)	Marginal Propensity to Consume (*MPC*)	Marginal Propensity to Save (*MPS*)
$9,000	$8,000			
10,000	8,750			
11,000	9,500			
12,000	10,250			
13,000	11,000			

2.11 **(Related to the Making the Connection on page 401)** In an opinion column in the *Wall Street Journal*, Purdue University President Mitchell Daniels wrote that "today's 20- and 30-year-olds are delaying marriage and delaying childbearing, both unhelpful trends from an economic and social standpoint." Why might young people be delaying marriage and childbearing? Why would this trend be unhelpful from an economic point of view? Is the trend possibly connected with the slow recovery from the 2007–2009 recession? Briefly explain.

Source: Mitchell E, Daniels, "How Student Debt Harms the Economy," *Wall Street Journal*, January 27, 2015.

2.12 **(Related to the Chapter Opener on page 381)** An article in the *Wall Street Journal* on changes in Intel's sales noted, "Intel sells its chips to customers in U.S. dollars, but many PC makers that buy those chips sell their products in local currencies." In these circumstances, would an increase in the value of the dollar relative to foreign currencies be likely to help or hurt Intel's sales? Briefly explain.

Source: Tess Stynes, "Intel Earnings: What to Watch," *Wall Street Journal*, July 15, 2015.

2.13 **(Related to the Making the Connection on page 406)** Briefly explain which of the following statement is correct.

a. The iPhone is made in China, using Chinese-made parts.
b. The iPhone is made in the United States, using U.S.-made parts.
c. The iPhone is made in the United States, using Chinese-made parts.
d. The iPhone is made China, using parts that are all made outside China.

What relevance does your answer have to how the Bureau of Economic Analysis calculates data on U.S. imports?

2.14 **(Related to the Making the Connection on page 406)** In a speech to a conference of government trade officials, Angel Gurría, secretary general of the Organization for Economic Co-operation and Development, made the following observation: "As goods and services cross borders several times at different stages of processing, conventional trade statistics may not tell the whole story."

a. What does Gurría mean by "conventional trade statistics"?
b. Why might conventional trade statistics no longer be as reliable as they once were?
c. What difficulties might the problems with trade statistics cause for policymakers?

Source: Angel Gurría, "Understanding Global Value Chains," Speech delivered at the G20 trade ministers conference in Puerto Vallarta, Mexico, April 19, 2012, www.oecd.org/about/secretary-general/g20understandingglobalvalucchains.htm.

12.3 Graphing Macroeconomic Equilibrium, pages 407–414

LEARNING OBJECTIVE: Use a 45°-line diagram to illustrate macroeconomic equilibrium.

Summary

The 45°-line diagram shows all the points where aggregate expenditure equals real GDP. On the 45°-line diagram, macroeconomic equilibrium occurs where the line representing the aggregate expenditure function crosses the 45° line. The economy is in recession when the aggregate expenditure line intersects the 45° line at a level of GDP that is below potential GDP. Numerically, macroeconomic equilibrium occurs when:

$$\text{Consumption} + \text{Planned investment} + \text{Government purchases} + \text{Net exports} = \text{GDP}.$$

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Review Questions

3.1 What is the meaning of the 45° line in the 45°-line diagram?

3.2 Use a 45°-line diagram to illustrate macroeconomic equilibrium. Make sure your diagram shows the aggregate expenditure function and the level of equilibrium real GDP and that your axes are properly labeled.

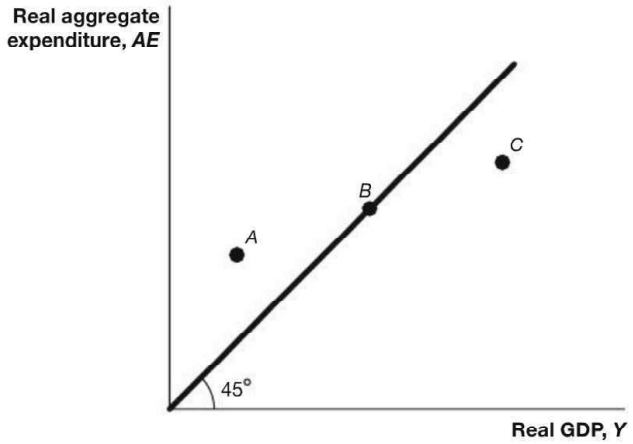
3.3 What does the slope of the aggregate expenditure line equal? How is the slope of the aggregate expenditure line related to the slope of the consumption function?

3.4 What is likely to happen if firms accumulate large amounts of unplanned inventory at the beginning of a recession?

3.5 What is the difference between aggregate expenditure and consumption spending?

Problems and Applications

3.6 At point *A* in the following graph, is planned aggregate expenditure greater than, equal to, or less than GDP? What about at point *B*? At point *C*? For points *A* and *C*, indicate the vertical distance that measures the unintended change in inventories.



3.7 Suppose we drop the assumption that net exports do not depend on real GDP. Draw a graph with the value of net exports on the vertical axis and the value of real GDP on the horizontal axis. Now, add a line representing the relationship between net exports and real GDP. Does your net exports line have a positive or negative slope? Briefly explain.

3.8 A Federal Reserve publication notes that "the shedding of unwanted inventories often accounts for a large portion of the decline in gross domestic product (GDP) during economic recessions." What does the author mean be "shedding of unwanted inventories"? What makes the inventories unwanted? Why would shedding inventories lead to a decline in GDP?

Source: Jeremy M. Piger, "Is the Business Cycle Still an Inventory Cycle?" *Economic Synopses*, Federal Reserve Bank of St. Louis, No. 2, 2005.

3.9 An article on bloomberg.com about the Japanese economy noted, "Whether the 2.4 percent annualized gain in gross domestic product reported Wednesday can be maintained depends on consumers stepping in to buy the products that companies are piling up in warehouses."

a. Did business inventories in Japan increase or decrease during this period? Briefly explain.

b. What would happen if consumers do not buy the products that companies are piling up? Illustrate your answer with a 45°-line diagram.

Source: Keiko Ujikane and Toru Fujioka, "Japan's Economy Grows as Investment Gains, Inventories Rise," bloomberg.com, May 20, 2015.

3.10 Consider the table in the next column, which shows the change in inventories for each quarter from the first quarter of 2007 (2007:I) through the fourth quarter of 2010 (2010:IV) measured in billions of 2009 dollars. Provide a macroeconomic explanation for this pattern. (*Hint:* When did the recession during this period begin and end?)

Accompanies problem 3.10.

Year	Quarter	Change in Inventories
2007	I	$19.6
	II	49.4
	III	50.2
	IV	23.0
2008	I	−20.2
	II	−26.4
	III	−20.7
	IV	−67.4
2009	I	−144.5
	II	−190.1
	III	−206.1
	IV	−49.6
2010	I	9.8
	II	48.8
	III	116.2
	IV	58.1

3.11 **(Related to the Don't Let This Happen to You on page 412)** Briefly explain whether you agree with the following argument: "The equilibrium level of GDP is determined by the level of aggregate expenditure. Therefore, GDP will decline only if households decide to spend less on goods and services."

3.12 **(Related to Solved Problem 12.3 on page 413)** Fill in the blank cells in the table below. Assume that the value of the *MPC* does not change as real GDP changes. Also assume that the values represent billions of 2009 dollars.

a. What is the value of the *MPC*?

b. What is the value of equilibrium real GDP?

Accompanies problem 3.12.

Real GDP (*Y*)	Consumption (*C*)	Planned Investment (*I*)	Government Purchases (*G*)	Net Exports (*NX*)	Planned Aggregate Expenditure (*AE*)	Unplanned Change in Inventories
$9,000	$7,600	$1,200	$1,200	−$400		
10,000	8,400	1,200	1,200	−400		
11,000		1,200	1,200	−400		
12,000		1,200	1,200	−400		
13,000		1,200	1,200	−400		

12.4 The Multiplier Effect, pages 414–421

LEARNING OBJECTIVE: Describe the multiplier effect and use the multiplier formula to calculate changes in equilibrium GDP.

Summary

Autonomous expenditure is expenditure that does not depend on the level of GDP. An autonomous change is a change in expenditure not caused by a change in income. An *induced change* is a change in aggregate expenditure caused by a change in income. An autonomous change in expenditure will cause rounds of induced changes in expenditure. Therefore, an autonomous change in expenditure will have a *multiplier effect* on equilibrium GDP. The **multiplier effect** is the process by which an increase in autonomous expenditure leads to a larger increase in real GDP. The **multiplier** is the ratio of the change in equilibrium GDP to the change in autonomous expenditure. The formula for the multiplier is:

$$\frac{1}{1 - MPC}.$$

Because of the paradox of thrift, an attempt by many individuals to increase their saving may lead to a reduction in aggregate expenditure and a recession.

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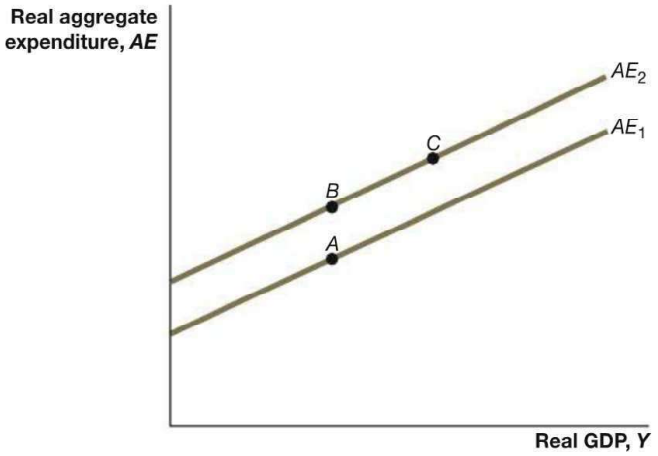
Review Questions

4.1 The following graph contains two aggregate expenditure functions. Consider a movement from point *A* to point *B* and a movement from point *B* to point C. Which movement shows a change in *autonomous* expenditure? Which movement shows a change in *induced* expenditure? Briefly explain your answers.



4.2 What is the multiplier effect? Use a 45°-line diagram to illustrate the multiplier effect of a decrease in government purchases.

4.3 What is the formula for the multiplier? Explain why this formula is considered to be too simple.

Problems and Applications

4.4 In Figure 12.13 on page 414, the economy is initially in equilibrium at point *A*. Aggregate expenditure and real GDP both equal $9.6 trillion. The increase in investment of $100 billion increases aggregate expenditure to $9.7 trillion. If real GDP increases to $9.7 trillion, will the economy be in equilibrium? Briefly explain. What happens to aggregate expenditure when real GDP increases to $9.7 trillion?

4.5 An opinion column in the *New York Times* quotes an economist's analysis of the effect of government infrastructure spending on new bridges and highways in the United States: "The investment multiplier would give a further kick to the U.S. economy."

a. What does the economist mean by the "investment multiplier"?

b. Briefly explain what the economist means by saying that the investment multiplier would "give a further kick to the U.S. economy."

Source: Thomas L. Friedman, "Why 2014 Is a Big Deal," *New York Times*, December 13, 2014.

4.6 **(Related to the Making the Connection on page 416)** If the multiplier had a value of 4 in 1929, how large must the change in autonomous expenditure have been to have caused the decline in real GDP between 1929 and 1933 shown in the table on page 417 ? If the multiplier had a value of 2, how large must the change in autonomous expenditure have been?

4.7 **(Related to Solved Problem 12.4 on page 419)** Use the information in the following table to answer the questions. Assume that the values represent billions of 2009 dollars.

Real GDP (*Y*)	Consumption (*C*)	Planned Investment (*I*)	Government Purchases (*G*)	Net Exports (*NX*)
$8,000	$7,300	$1,000	$1,000	−$500
9,000	7,900	1,000	1,000	−500
10,000	8,500	1,000	1,000	−500
11,000	9,100	1,000	1,000	−500
12,000	9,700	1,000	1,000	−500

a. What is the equilibrium level of real GDP?

b. What is the *MPC*?

c. Suppose net exports increase by $400 billion. What will be the new equilibrium level of real GDP? Use the multiplier formula to determine your answer.

4.8 An article published in an economics journal found the following: "For the poorest households, the marginal propensity to consume was close to 70%. For the richest households, the *MPC* was only 35%." Assume that the macroeconomy can be divided into three sections. Section A consists of the poorest households, Section B consists of the richest households, and Section C consists of all other households.

a. Compute the value of the multiplier for Section A.

b. Compute the value of the multiplier for Section B.

c. Assume that there was an increase in planned investment of $4 billion. Compute the change in equilibrium real GDP if the *MPC* for the economy was 70 percent (or 0.70). Compute the change in equilibrium real GDP if the *MPC* for the economy was 35 percent (or 0.35).

Source: Atif Mian and Amir Sufi, "Who Spends Extra Cash?" *House of Debt*, April 13, 2014.

4.9 Explain whether each of the following would cause the value of the multiplier to be larger or smaller.

a. An increase in real GDP increases imports.

b. An increase in real GDP increases interest rates.

c. An increase in real GDP increases the marginal propensity to consume.

d. An increase in real GDP causes the average tax rate paid by households to decrease.

e. An increase in real GDP increases the price level.

4.10 Suppose the rate of growth of the economies in the BRIC nations (Brazil, Russia, India, and China) slows down, causing U.S. net exports to fall by $75 billion. If the *MPC* is 0.8, what will be the change in equilibrium U.S. GDP?

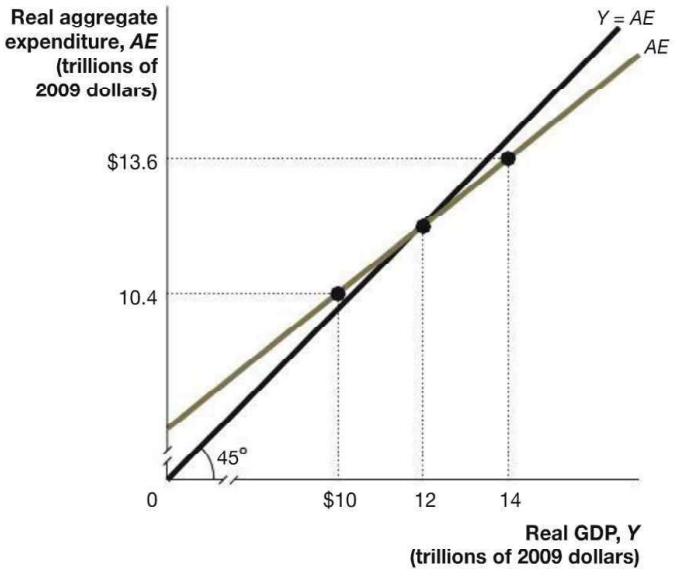
4.11 Would a larger multiplier lead to longer and more severe recessions or shorter and less severe recessions? Briefly explain.

4.12 A study by the management consulting company McKinsey & Company recommended that the U.S. increase spending on infrastructure, such as bridges and highways, by between $150 and $180 billion per year. The study estimated that the result would be an increase in GDP of between $270 billion and $320 billion per year. What is the implied value of the multiplier if the McKinsey study's estimate of the effect of infrastructure spending on GDP is correct?

Source: David Harrison, "Nation's Crumbling Roads Put a Dent in Drivers' Wallets," *Wall Street Journal*, July 31, 2015.

4.13 Use the following graph to answer the questions.

a. What is the value of equilibrium real GDP?
b. What is the value of the *MPC*?
c. What is the value of the multiplier?
d. What is the value of unplanned changes in inventories when real GDP has each of the following values?
   i. $10 trillion
   ii. $12 trillion
   iii. $14 trillion



12.5 The Aggregate Demand Curve, pages 421–422

LEARNING OBJECTIVE: Understand the relationship between the aggregate demand curve and aggregate expenditure.

Summary

Increases in the price level cause a reduction in consumption, investment, and net exports. This causes the aggregate expenditure function to shift down on the 45°-line diagram, leading to a lower equilibrium real GDP. A decrease in the price level leads to a higher equilibrium real GDP. The **aggregate demand (AD) curve** shows the relationship between the price level and the level of aggregate expenditure, holding constant all factors other than the price level that affect aggregate expenditure.

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Review Questions

5.1 Explain the difference between aggregate expenditure and aggregate demand.

5.2 Explain which components of aggregate expenditure are affected by a change in the price level.

5.3 Does a change in the price level cause a movement along the aggregate expenditure line or a shift of the aggregate expenditure line? Does a change in the price level cause a movement along the aggregate demand curve or a shift of the aggregate demand curve?

Problems and Applications

5.4 Explain why the aggregate expenditure line is upward sloping, while the aggregate demand curve is downward sloping.

5.5 Explain whether you agree with the following statement: "The reason the aggregate demand curve slopes downward is that when the price level is higher, people cannot afford to buy as many goods and services."

5.6 Suppose that exports become more sensitive to changes in the price level in the United States. That is, when the price level in the United States rises, exports decline by more than they previously did. Will this change make the aggregate demand curve steeper or less steep? Briefly explain.

Real-Time Data Exercises

D12.1 **(Calculating the multiplier effect)** Using data from the Federal Reserve Bank of St. Louis (FRED) (research.stlouisfed.org/fred2/), analyze the effect of a decline in exports on GDP.

a. Download data since 1990 on Real Exports of Goods and Services (EXPGSC1).
b. What was the dollar value of the decline in real exports between the second quarter of 2008 and the first quarter of 2009? If the multiplier is 2, holding everything else constant, what was the effect of this decline in exports on real GDP?

Appendix

The Algebra of Macroeconomic Equilibrium

LEARNING OBJECTIVE: Apply the algebra of macroeconomic equilibrium.

In this chapter, we relied primarily on graphs and tables to illustrate the aggregate expenditure model of short-run real GDP. Graphs help us understand economic change *qualitatively*. When we write an economic model using equations, we make it easier to make *quantitative estimates*. When economists forecast future movements in GDP, they often rely on *econometric models*. An econometric model is an economic model written in the form of equations, where each equation has been statistically estimated using methods similar to the methods used in estimating demand curves that we briefly described in Chapter 3. We can use equations to represent the aggregate expenditure model described in this chapter.

The following equations are based on the example shown in Table 12.3 on page 412. Y stands for real GDP, and the numbers (with the exception of the *MPC*) represent billions of dollars.

1.	$C = 1{,}000 + 0.65Y$	Consumption function
2.	$I = 1{,}500$	Planned investment function
3.	$G = 1{,}500$	Government purchases function
4.	$NX = -500$	Net export function
5.	$Y = C + I + G + NX$	Equilibrium condition

The first equation is the consumption function. The *MPC* is 0.65, and 1,000 is autonomous consumption, which is the level of consumption that does not depend on income. If we think of the consumption function as a line on the 45°-line diagram, 1,000 would be the intercept, and 0.65 would be the slope. The "functions" for the other three components of planned aggregate expenditure are very simple because we have assumed that these components are not affected by GDP and, therefore, are constant. Economists who use this type of model to forecast GDP would, of course, use more realistic investment, government, and net export functions. The *parameters* of the functions—such as the value of autonomous consumption and the value of the *MPC* in the consumption function—would be estimated statistically, using data on the values of each variable over a period of years.

In this model, GDP is in equilibrium when it equals planned aggregate expenditure. Equation 5—the equilibrium condition—shows us how to calculate equilibrium in the model: We need to substitute equations 1 through 4 into equation 5. Doing so gives us the following:

$$Y = 1{,}000 + 0.65Y + 1{,}500 + 1{,}500 - 500.$$

We need to solve this expression for Y to find equilibrium GDP. The first step is to subtract $0.65Y$ from both sides of the equation:

$$Y - 0.65Y = 1{,}000 + 1{,}500 + 1{,}500 - 500.$$

Then, we solve for Y:

$$0.35Y = 3{,}500.$$

Or:

$$Y = \frac{3{,}500}{0.35} = 10{,}000.$$

To make this result more general, we can replace particular values with general values represented by letters:

1.	$C = \bar{C} + MPC(Y)$	Consumption function
2.	$I = \bar{I}$	Planned investment function
3.	$G = \bar{G}$	Government purchases function
4.	$NX = \overline{NX}$	Net export function
5.	$Y = C + I + G + NX$	Equilibrium condition

The letters with bars over them represent fixed, or autonomous, values. So, for example, $\bar{C}$ represents autonomous consumption, which had a value of 1,000 in our original example. Now, solving for equilibrium, we get:

$$Y = \bar{C} + MPC(Y) + \bar{I} + \bar{G} + \overline{NX},$$

or:

$$Y - MPC(Y) = \bar{C} + \bar{I} + \bar{G} + \overline{NX},$$

or:

$$Y(1 - MPC) = \bar{C} + \bar{I} + \bar{G} + \overline{NX},$$

or:

$$Y = \frac{\bar{C} + \bar{I} + \bar{G} + \overline{NX}}{1 - MPC}.$$

Remember that $1/(1 - MPC)$ is the multiplier, and all four variables in the numerator of the equation represent autonomous expenditure. Therefore, an alternative expression for equilibrium GDP is:

$$\text{Equilibrium GDP} = \text{Autonomous expenditure} \times \text{Multiplier}.$$

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12A The Algebra of Macroeconomic Equilibrium, pages 430–431

LEARNING OBJECTIVE: Apply the algebra of macroeconomic equilibrium.

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Review Questions

12A.1 Write a general expression for the aggregate expenditure function. If you think of the aggregate expenditure function as a line on the 45°-line diagram, what would be the intercept and what would be the slope, using the general values represented by letters?

12A.2 Find equilibrium GDP using the following macroeconomic model (where the numbers, with the exception of the *MPC*, represent billions of dollars).

1. $C = 1{,}500 + 0.75Y$	Consumption function
2. $I = 1{,}250$	Planned investment function
3. $G = 1{,}250$	Government purchases function
4. $NX = -250$	Net export function
5. $Y = C + I + G + NX$	Equilibrium condition

12A.3 For the macroeconomic model in problem 12A.2, write the aggregate expenditure function. For GDP of $16,000, what is the value of aggregate expenditure, and what is the value of the unintended change in inventories? For GDP of $12,000, what is the value of aggregate expenditure, and what is the value of the unintended change in inventories?

12A.4 Suppose that autonomous consumption is 500, government purchases are 1,000, planned investment spending is 1,250, net exports are −250, and the *MPC* is 0.8. What is equilibrium GDP?