8 Aggregate Expenditure and Equilibrium Output

In the last several chapters we described a number of features of the U.S. economy, including real GDP, inflation, and unemployment, and we talked about how they are measured. Now we begin the analytical part of macroeconomics: How do the different parts of the economy interact to produce the time-profile of the U.S. economy that we described in the last few chapters?

We begin with the simplest case, focusing on households and firms, we ask what happens to the economy as a whole when investment increases. If suddenly all the managers of firms in the economy decided to expand their plants, how would that affect households and aggregate output? Once we understand how households and firms interact at the aggregate level, we will introduce government in Chapter 9. In subsequent chapters, we will make our simple economic model both more realistic, and as a result more complex, but the basic intuitions of these early chapters will remain. As we work through our model of the economy, we focus, at least initially, on understanding movements in real gross domestic product (GDP), one of the measures of macroeconomic activity. We focus on real, rather than nominal, output because we are interested in tracking real changes in the level of economic activity. So, although we will typically use dollars to measure GDP, you should think about this as dollars corrected for price level changes.

CHAPTER OUTLINE AND LEARNING OBJECTIVES

8.1 The Keynesian Theory of Consumption *p. 170*
Explain the principles of the Keynesian theory of consumption.

8.2 Planned Investment (*I*) versus Actual Investment *p. 175*
Explain the difference between planned investment and actual investment.

8.3 Planned Investment and the Interest Rate (*r*) *p. 175*
Understand how planned investment is affected by the interest rate.

8.4 The Determination of Equilibrium Output (Income) *p. 176*
Explain how equilibrium output is determined.

8.5 The Multiplier *p. 180*
Describe the multiplier process and use the multiplier equation to calculate changes in equilibrium.

Looking Ahead *p. 185*

Appendix: Deriving the Multiplier Algebraically *p. 189*
Show that the multiplier is one divided by one minus the MPC.

We saw previously that GDP can be calculated in terms of either income or expenditures. We will use the variable *Y* to refer to both **aggregate output** and **aggregate income**.

aggregate output The total quantity of goods and services produced in an economy in a given period.

aggregate income The total income received by all factors of production in a given period.

In any given period, there is an exact equality between aggregate output (production) and aggregate income. You should be reminded of this fact whenever you encounter the combined term **aggregate output (income) (*Y*)**.

aggregate output (income) (*Y*) A combined term used to remind you of the exact equality between aggregate output and aggregate income.

Aggregate output can also be considered the aggregate quantity supplied because it is the amount that firms are supplying (producing) during a period. In the discussions that follow, we use the term *aggregate output* (*income*) instead of *aggregate quantity supplied*, but keep in mind that the two are equivalent. Also remember that *aggregate output* means "real GDP." For ease of discussion we will sometimes refer to aggregate output (income) as simply "output" or "income."

From the outset, you must think in "real terms." For example, when we talk about output (*Y*), we mean real output, not nominal output. In the current chapter and the next, we will assume the overall price level (*P*) is fixed, so those nominal and real outputs are the same. Nevertheless, because eventually we will introduce the possibility of a changing price level, it is useful now to begin thinking of output (*Y*) as being in real terms.

8.1 LEARNING OBJECTIVE

Explain the principles of the Keynesian theory of consumption.

The Keynesian Theory of Consumption

In 2016, the average U.S. family spent about $1,800 on clothing. For high-income families earning more than $150,000, the amount spent on clothing was higher, at about $5,500. We all recognize that for consumption as a whole, as well as for consumption of most specific categories of goods and services, consumption rises with income. This relationship between consumption and income is central to Keynes's model of the economy. Although Keynes recognized that many factors, including wealth and interest rates, play a role in determining consumption levels in the economy, in his classic *The General Theory of Employment, Interest, and Money*, current income played the key role:

> The fundamental psychological law, upon which we are entitled to depend with great confidence both *a priori* from our knowledge of human nature and from the detailed facts of experience, is that men [and women, too] are disposed, as a rule and on average, to increase their consumption as their incomes increase, but not by as much as the increase in their income.[1]

Keynes is telling us two things in this quote. First, if you find your income going up, you will spend more than you did before. Keynes is also saying something about how much more you will spend: he predicts—based on his looking at the data and his understanding of people—that the rise in consumption will be less than the full rise in income. This simple observation plays a large role in helping us understand the workings of the aggregate economy.

consumption function The relationship between consumption and income.

The relationship between consumption and income is called a **consumption function**. Figure 8.1 shows a hypothetical consumption function for an individual household. The curve is labeled *c*(*y*), which is read "*c* is a function of *y*," or "consumption is a function of income." Note that we have drawn the line with an upward slope, showing that consumption increases with income. To reflect Keynes's view that consumption increases less than one for one with income, we have drawn the consumption function with a slope of less than 1. The consumption function in Figure 8.1 is a straight line, telling us that an increase in income of $1 leads to the same increase in consumption regardless of the initial value of income. In practice, the consumption function may be curved, with the slope decreasing as income increases. This would tell us that the typical consumer spends less of the incremental income received as his or her income rises.

The consumption function in Figure 8.1 represents an individual household. In macroeconomics, however, we are interested in the behavior of the economy as a whole, the aggregate

[1] John Maynard Keynes, *The General Theory of Employment, Interest, and Money* (1936), First Harbinger Ed. (New York: Harcourt Brace Jovanovich, 1964), p. 96.

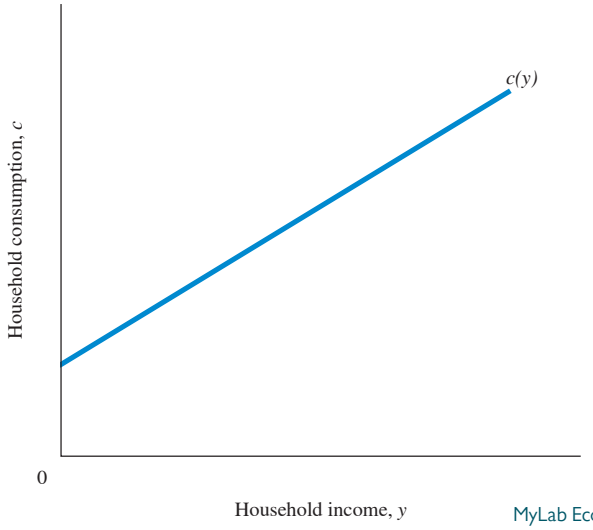

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FIGURE 8.1
A Consumption Function for a Household
A consumption function for an individual household shows the level of consumption at each level of household income.

consumption of all households in the economy in relation to aggregate income. Figure 8.2 shows this aggregate consumption function, again using a straight line, or constant slope, for simplicity. With a straight-line consumption curve, we can use the following equation to describe the curve:

$$C = a + bY$$

Y is aggregate output (income), C is aggregate consumption, and a is the point at which the consumption function intersects the vertical axis—a constant. The letter b is the slope of the line, in this case $\Delta C/\Delta Y$ [because consumption (C) is measured on the vertical axis and income (Y) is measured on the horizontal axis].[2] Every time income increases (say by ΔY), consumption increases by b times ΔY. Thus, $\Delta C = b \times \Delta Y$ and $\Delta C/\Delta Y = b$. Suppose, for example, that the slope of the line in Figure 8.2 is 0.75 (that is, $b = .75$). An increase in income (ΔY) of \$1,000 would then increase consumption by $b\Delta Y = 0.75 \times \$1{,}000$, or \$750.

The **marginal propensity to consume (*MPC*)** is the fraction of a change in income that is consumed, or spent. In the consumption function here, b is the *MPC*. An *MPC* of .75 means consumption changes by \$0.75 for every \$1.00 increase in income. The slope of the consumption function is the *MPC*. An *MPC* less than 1 tells us that individuals spend less than 100 percent of their additional income, just as Keynes suggested.

marginal propensity to consume (*MPC*) The fraction of a change in income that is consumed, or spent.

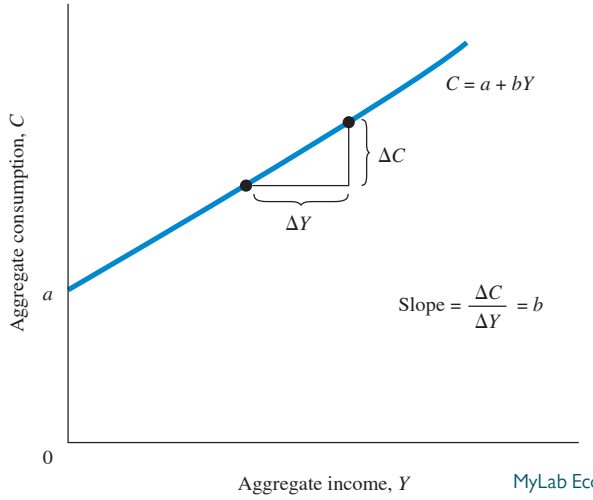

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FIGURE 8.2
An Aggregate Consumption Function
The aggregate consumption function shows the level of aggregate consumption at each level of aggregate income. The upward slope indicates that higher levels of income lead to higher levels of consumption spending.

[2] The Greek letter Δ (delta) means "change in." For example, ΔY (read "delta Y") means the "change in income." If income (Y) in 2012 is \$100 and income in 2013 is \$110, then ΔY for this period is $\$110 - \$100 = \$10$. For a review of the concept of slope, see Appendix, Chapter 1.

$$\text{marginal propensity to consume} \equiv \text{slope of consumption function} \equiv \frac{\Delta C}{\Delta Y}$$

aggregate saving (*S*) The part of aggregate income that is not consumed.

Aggregate saving (*S*) in the economy, denoted *S*, is the difference between aggregate income and aggregate consumption:

$$S \equiv Y - C$$

identity Something that is always true by definition.

The triple equal sign means that this equation is an **identity**, or something that is always true by definition. This equation simply says that income that is not consumed must be saved. If $0.75 of a $1.00 increase in income goes to consumption, $0.25 must go to saving. If income decreases by $1.00, consumption will decrease by $0.75 and saving will decrease by $0.25. The **marginal propensity to save (*MPS*)** is the fraction of a change in income that is saved: $\Delta S / \Delta Y$, where ΔS is the change in saving. Everything not consumed is saved, so the *MPC* and the *MPS* must add up to 1.

marginal propensity to save (*MPS*) That fraction of a change in income that is saved.

$$MPC + MPS \equiv 1$$

The *MPC* and the *MPS* are important concepts, as such it may help to review their definitions. The marginal propensity to consume (*MPC*) is the fraction of an increase in income that is consumed (or the fraction of a decrease in income that comes out of consumption).

The marginal propensity to save (*MPS*) is the fraction of an increase in income that is saved (or the fraction of a decrease in income that comes out of saving).

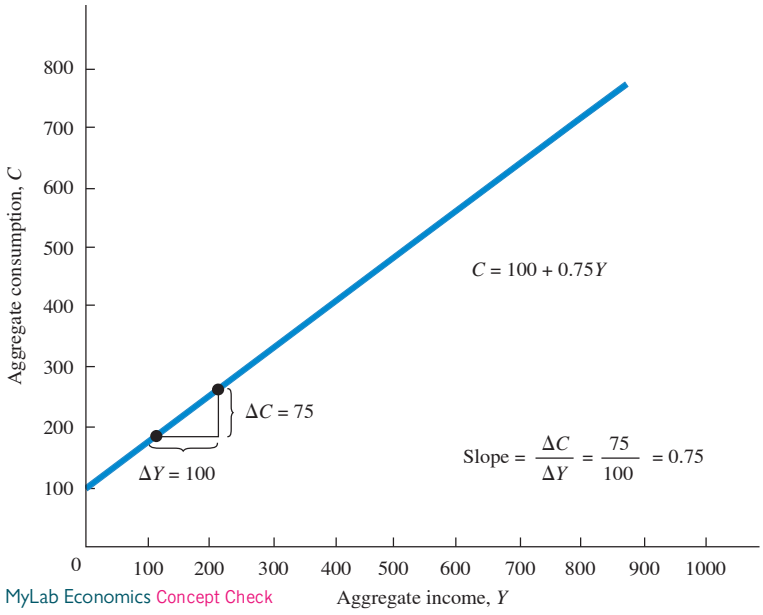
The numerical examples used in the rest of this chapter are based on the following consumption function:

$$C = \underbrace{100}_{a} + \underbrace{0.75\,Y}_{b}$$

This equation is simply an extension of the generic $C = a + bY$ consumption function we have been discussing, where *a* is 100 and *b* is 0.75. This function is graphed in Figure 8.3.

FIGURE 8.3 The Aggregate Consumption Function Derived from the Equation $C = 100 + 0.75Y$

In this simple consumption function, consumption is 100 at an income of zero. As income rises, so does consumption. For every 100 increase in income, consumption rises by 75. The slope of the line is 0.75.



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Aggregate Income, *Y*	Aggregate Consumption, *C*
0	100
80	160
100	175
200	250
400	400
600	550
800	700
1,000	850

Because saving and consumption by definition add up to income, we can use the consumption curve to tell us about both consumption and saving. We do this in Figure 8.4. In this figure, we have drawn a 45-degree line from the origin. Everywhere along this line aggregate consumption is equal to aggregate income. Therefore, saving is zero. Where the consumption curve is *above* the 45-degree line, consumption exceeds income and saving is negative, that is, people borrow. Where the consumption function *crosses* the 45-degree line, consumption is equal to income and saving is zero. Where the consumption function is *below* the 45-degree line, consumption is less than income and saving is positive. Note that the slope of the saving function is $\Delta S/\Delta Y$, which is equal to the marginal propensity to save (*MPS*). The consumption function and the saving function are mirror images of each other. No information appears in one that does not appear in the other. These functions tell us how households in the aggregate will divide income between consumption spending and saving at every possible income level. In other words, they embody aggregate household behavior.

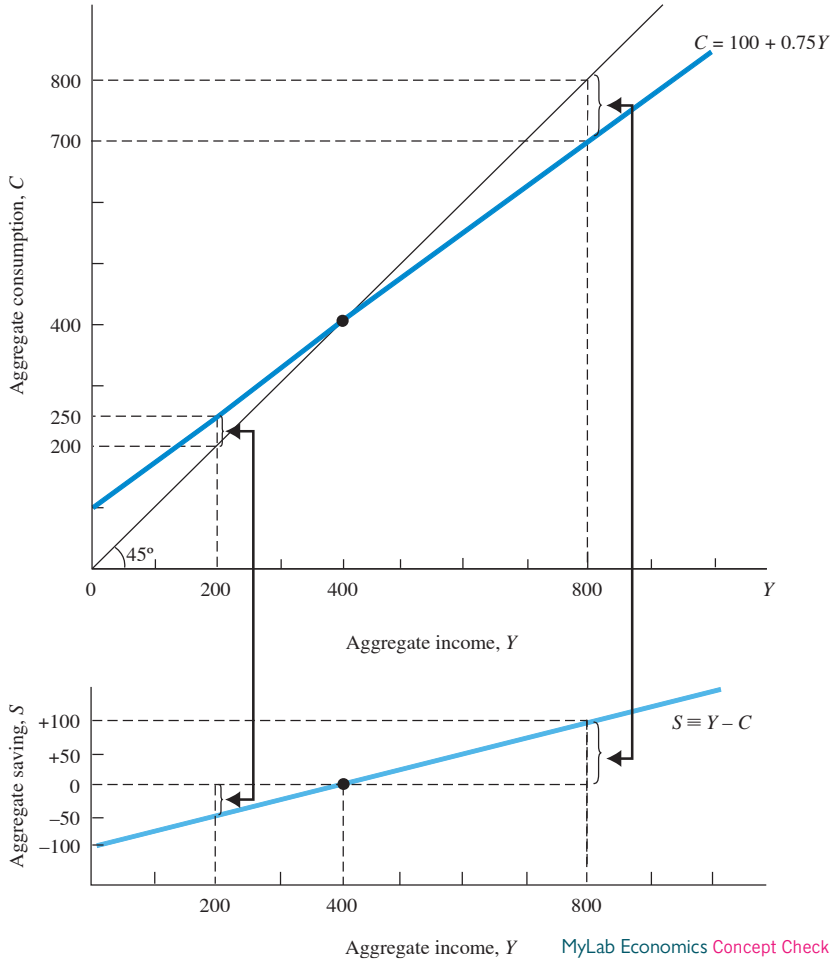

FIGURE 8.4 Deriving the Saving Function from the Consumption Function in Figure 8.3
Because $S \equiv Y - C$, it is easy to derive the saving function from the consumption function. A 45-degree line drawn from the origin can be used as a convenient tool to compare consumption and income graphically. At $Y = 200$, consumption is 250. The 45-degree line shows us that consumption is larger than income by 50. Thus $S \equiv Y - C = -50$. At $Y = 800$, consumption is less than income by 100. Thus $S = 100$ when $Y = 800$.

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Y	$-$	C	$=$	S
Aggregate Income		Aggregate Consumption		Aggregate Saving
0		100		−100
80		160		−80
100		175		−75
200		250		−50
400		400		0
600		550		50
800		700		100
1,000		850		150

ECONOMICS IN PRACTICE

Behavioral Biases in Saving Behavior

This chapter has described how saving is related to income. Economists have generally assumed that people make their saving decisions rationally, just as they make other decisions about choices in consumption and the labor market. Saving decisions involve thinking about trade-offs between present and future consumption. Recent work in behavioral economics has highlighted the role of psychological biases in saving behavior and has demonstrated that seemingly small changes in the way saving programs are designed can result in big behavioral changes.

Many retirement plans are designed with an opt-in feature. That is, you need to take some action to enroll. Typically, when you begin a job, you need to check "yes" on the retirement plan enrollment form. Recent work in economics by James Choi of Yale University, Brigitte Madrian of Harvard, and Dennis Shea, head of executive compensation at Aetna, suggests that simply changing the enrollment process from the opt-in structure just described to an opt-out system in which people are automatically enrolled unless they check the "no" box dramatically increases enrollment in retirement pension plans. In one study, the change from an opt-in to an opt-out system increased pension plan enrollment after three months of work from 65 percent to 98 percent of workers.

Behavioral economists have administered a number of surveys suggesting that people, on average, think they save too little of their income for retirement. Shlomo Benartzi, from the University of California, Los Angeles, and Richard Thaler, recent Nobel prize winner from the University of Chicago, devised a retirement program to try to increase saving rates. Under this plan, called Save More Tomorrow, employees are offered a program that allows them to precommit to save more whenever they get a pay raise. Behavioral economists argue that people find this option attractive because

it is easier for them to commit to making sacrifices tomorrow than it is for them to make those sacrifices today. (This is why many people resolve to diet sometime in the future but continue to overeat today.) The Save More Tomorrow retirement plans have been put in place in a number of companies, including Vanguard, T. Rowe Price, and TIAA-CREF. Early results suggest dramatic increases in the saving rates of those enrolled, with saving rates quadrupling after four years and four pay raises.

CRITICAL THINKING

1. The Save More Tomorrow Plans encourage people to save more by committing themselves to future action. Can you think of examples in your own life of similar commitment devices you use?

Other Determinants of Consumption MyLab Economics Concept Check

The assumption that consumption depends only on income is obviously a simplification. In practice, the decisions of households on how much to consume in a given period are also affected by their wealth, by the interest rate, and by their expectations of the future. Households with higher wealth are likely to spend more, other things being equal, than households with less wealth, even at the same income level. As we will see, these other factors shift the consumption function.

The boom in the U.S. stock market in the last half of the 1990s and the boom in housing prices between 2003 and 2005, both of which increased household wealth substantially, led households to consume more than they otherwise would have in these periods. In 2009–2010, after a fall in housing prices and the stock market, consumption was less than it otherwise would have been.

For many households, interest rates also figure in to consumption and saving decisions. Lower interest rates reduce the cost of borrowing, so lower interest rates are likely to stimulate spending. (Conversely, higher interest rates increase the cost of borrowing and are likely to decrease spending.) Finally, as households think about what fraction of incremental income to

consume versus save, their expectations about the future may also play a role. If households are optimistic and expect to do better in the future, they may spend more at present than if they think the future will be bleak.

Household expectations are also important regarding households' responses to changes in their income. If, for example, the government announces a tax cut, which increases after-tax income, households' responses to the tax cut will likely depend on whether the tax cut is expected to be temporary or permanent. If households expect that the tax cut will be in effect for only two years, their responses are likely to be smaller than if they expect the tax cut to be permanent.

We examine these issues in Chapter 15, where we take a closer look at household behavior regarding both consumption and labor supply. But for now, we will focus only on income, given that it is the most important determinant of consumption.

Planned Investment (I) versus Actual Investment

8.2 LEARNING OBJECTIVE

Explain the difference between planned investment and actual investment.

The output of an economy consists not only of goods consumed by households, but investments made by firms. Some firms' investments are in the form of plant and equipment. These investments in many ways look like some consumption expenditures of households. In a given period, a firm might buy $500,000 of new machinery, which would be part of aggregate output for the period, as would the purchase of automobiles by households. In Chapter 6, you learned that firms' investments also include inventories. Understanding how firms invest in inventories is a little more complicated, but it is important for understanding the way the macroeconomy works.

A firm's inventory is the stock of goods that it has awaiting sale. For many reasons, most firms want to hold some inventory. It is hard to predict exactly when consumers will want to purchase a new refrigerator, and most customers are not patient. Sometimes it is cheaper to produce goods in larger volumes than current demand requires, which leads firms to produce more than they need this period to hold for sale in a later period. From a macroeconomic perspective, however, inventory differs from other capital investments in one important way: although purchases by firms of machinery and equipment are *always* deliberate, *sometimes* inventories build up (or decline) without any deliberate plan by firms. For this reason, there can be a difference between **planned investment**, which consists of the investments firms *plan* to make, and **actual investment**, which consists of all of firms' investments, including their unplanned changes in inventories. Remember that in Chapter 6 we used I^a to denote actual investment. We will always use I to denote planned investment.

planned investment (I) Those additions to capital stock and inventory that are planned by firms.

actual investment (I^a) The actual amount of investment that takes place; it includes items such as unplanned changes in inventories.

Why are inventories sometimes different from what was planned? Recall that firms hold planned inventories in anticipation of sales, recognizing that the exact timing of sales may be uncertain. If a firm overestimates how much it will sell in a period, it will end up with more in inventory than it planned to have. On other occasions, inventories may be lower than planned when sales are stronger than expected. As we will see shortly, the economy is in equilibrium only when planned investment and actual investment are equal.

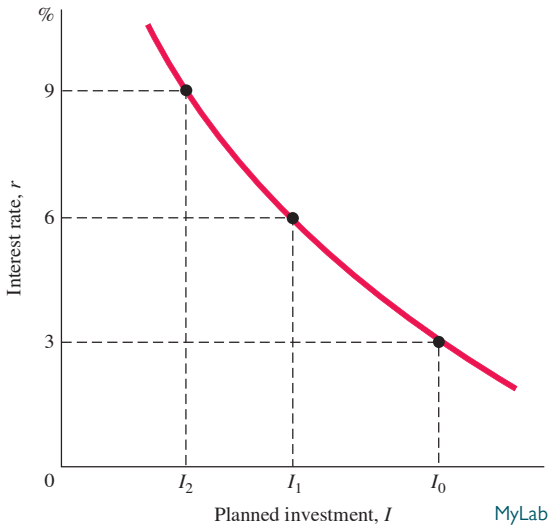
Planned Investment and the Interest Rate (r)

8.3 LEARNING OBJECTIVE

Understand how planned investment is affected by the interest rate.

We have seen that there is an important difference between planned investment and actual investment, and this distinction will play a key role in the discussion of equilibrium in this chapter. But another important question is what determines planned investment in the first place? In practice, planned investment depends on many factors, as you would expect, but here we focus on just one: the interest rate. Recall that investment includes a firm's purchase of new capital—new machines and plants. Whether a firm decides to invest in new capital depends on whether the expected profits from that machinery and those plants justify their costs. One cost of an investment project is the interest cost. When a manufacturing firm builds a new plant, the contractor must be paid at the time the plant is built. The money needed to carry out such projects is generally borrowed and

FIGURE 8.5 Planned Investment Schedule
Planned investment spending is a negative function of the interest rate. An increase in the interest rate from 3 percent to 6 percent reduces planned investment from I_0 to I_1.



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paid back over an extended period. The real cost of an investment project thus depends in part on the interest rate—the cost of borrowing. When the interest rate rises, it becomes more expensive to borrow and fewer projects are likely to be undertaken; increasing the interest rate, *ceteris paribus*, is likely to reduce the level of planned investment spending. When the interest rate falls, it becomes less costly to borrow and more investment projects are likely to be undertaken; reducing the interest rate, *ceteris paribus*, is likely to increase the level of planned investment spending.

The relationship between the interest rate and planned investment is illustrated by the downward-sloping demand curve in Figure 8.5. The higher the interest rate, the lower the level of planned investment. At an interest rate of 3 percent, planned investment is I_0. When the interest rate rises from 3 to 6 percent, planned investment falls from I_0 to I_1. As the interest rate falls, however, more projects become profitable, so more investment is undertaken. The curve in Figure 8.5 is sometimes called the "marginal efficiency of investment" curve.

Other Determinants of Planned Investment MyLab Economics Concept Check

The assumption that planned investment depends only on the interest rate is obviously a simplification, just as is the assumption that consumption depends only on income. In practice, the decision of a firm on how much to invest depends on, among other things, its expectation of future sales. If a firm expects that its sales will increase in the future, it may begin to build up its capital stock—that is, to invest—now so that it will be able to produce more in the future to meet the increased level of sales. The optimism or pessimism of entrepreneurs about the future course of the economy can have an important effect on current planned investment. Keynes used the phrase *animal spirits* to describe the feelings of entrepreneurs, and he argued that these feelings affect investment decisions significantly.

We will come back to this issue in Chapter 15, where we will take a closer look at firm behavior (and household behavior), but until then to complete our simple model we will assume that planned investment depends only on the interest rate.

8.4 LEARNING OBJECTIVE
Explain how equilibrium output is determined.

The Determination of Equilibrium Output (Income)

Thus far, we have described the behavior of firms and households. In this simple setting, how does the economy achieve equilibrium and what does that equilibrium look like?

A number of definitions of **equilibrium** are used in economics but all use the idea that at equilibrium, there is no tendency for change. In microeconomics, equilibrium is said to exist in a particular market (for example, the market for bananas) at the price for which the quantity demanded is equal to the quantity supplied. At this point, both suppliers and demanders are satisfied. The equilibrium price of a good is the price at which suppliers want to furnish the amount that demanders want to buy. In the macroeconomic goods market, we will use a similar definition of equilibrium focused on a match between what is planned and what actually happens.

equilibrium The condition that exists when quantity supplied and quantity demanded are equal. At equilibrium, there is no tendency for price to change.

To define equilibrium for the macroeconomy, we start with a new variable, **planned aggregate expenditure (*AE*)**. Planned aggregate expenditure is, by definition, consumption plus planned investment:

planned aggregate expenditure (*AE*) The total amount the economy plans to spend in a given period. Equal to consumption plus planned investment: $AE \equiv C + I$

$$AE \equiv C + I$$

Note that I is planned investment spending only. It does not include any unplanned increases or decreases in inventory. Note also that this is a definition. Aggregate expenditure is always equal to $C + I$, and we write it with the triple equal sign.

The economy is defined to be in equilibrium when aggregate output (Y) is equal to planned aggregate expenditure (AE).

$$\text{Equilibrium: } Y = AE$$

Because AE is, by definition, $C + I$, equilibrium can also be written:

$$\text{Equilibrium: } Y = C + I$$

It will help in understanding the equilibrium concept to consider what happens if the economy is out of equilibrium. First, suppose aggregate output is greater than planned aggregate expenditure:

$$Y > C + I$$

$$\text{aggregate output} > \text{planned aggregate expenditure}$$

When output is greater than planned spending, there is unplanned inventory investment. For some reason, consumers bought fewer goods than firms anticipated, and the unsold goods turned up in the form of unplanned inventory.

Suppose instead that planned aggregate expenditure is greater than aggregate output:

$$C + I > Y$$

$$\text{planned aggregate expenditure} > \text{aggregate output}$$

When planned spending exceeds output, firms have sold more than they planned to. Consumers have bought more than was expected, and firms are left with lower inventory levels than they planned. Planned and actual investment are not equal. Only when output is exactly matched by planned spending will there be no unplanned inventory investment. If there is unplanned inventory investment, this will be a state of disequilibrium. The mechanism by which the economy returns to equilibrium will be discussed later. Equilibrium in the goods market is achieved only when aggregate output (Y) and planned aggregate expenditure ($C + I$) are equal, or when actual and planned investment are equal.

Table 8.1 derives a planned aggregate expenditure schedule and shows the point of equilibrium for our numerical example. I is assumed to be fixed and equal to 25 for these calculations. Remember that I depends on the interest rate, but the interest rate is fixed for purposes of this chapter. Remember also that all our calculations are based on $C = 100 + 0.75Y$. To determine planned aggregate expenditure, we add consumption spending (C) to planned investment spending (I) at every level of income. Glancing down columns (1) and (4), we see one and only one level at which aggregate output and planned aggregate expenditure are equal: $Y = 500$.

Figure 8.6 illustrates the same equilibrium graphically. Figure 8.6a adds planned investment, fixed at 25, to consumption at every level of income. Because planned investment is a constant, the planned aggregate expenditure function is simply the consumption function displaced vertically by that constant amount. Figure 8.6b shows the planned aggregate expenditure

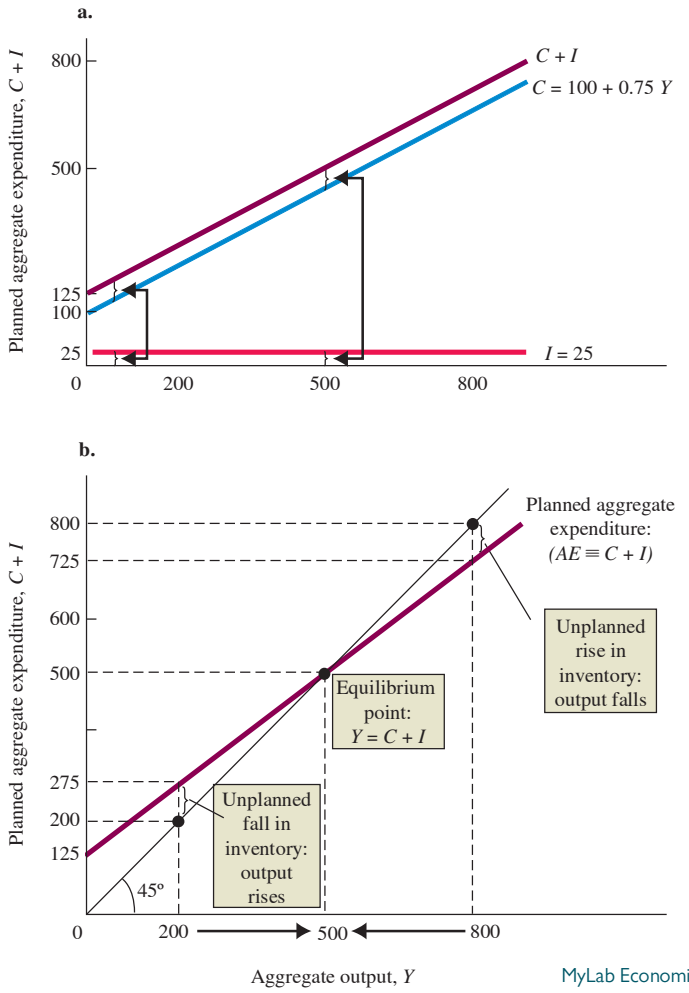
TABLE 8.1 Deriving the Planned Aggregate Expenditure Schedule and Finding Equilibrium.*

(1) Aggregate Output (Income) (Y)	(2) Aggregate Consumption (C)	(3) Planned Investment (I)	(4) Planned Aggregate Expenditure (AE) $C+I$	(5) Unplanned Inventory Change $Y-(C+I)$	(6) Equilibrium? ($Y-AE$?)
100	175	25	200	−100	No
200	250	25	275	−75	No
400	400	25	425	−25	No
500	**475**	**25**	**500**	**0**	**Yes**
600	550	25	575	+25	No
800	700	25	725	+75	No
1,000	850	25	875	+125	No

*The figures in column (2) are based on the equation $C = 100 + 0.75Y$.

function with the 45-degree line. The 45-degree line represents all points on the graph where the variables on the horizontal and vertical axes are equal. Any point on the 45-degree line is a potential equilibrium point. The planned aggregate expenditure function crosses the 45-degree line at a single point, where $Y = 500$. (The point at which the two lines cross is sometimes called the *Keynesian cross*.) At that point, $Y = C + I$.

FIGURE 8.6
Equilibrium Aggregate Output
Equilibrium occurs when planned aggregate expenditure and aggregate output are equal. Planned aggregate expenditure is the sum of consumption spending and planned investment spending.



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Now let us look at some other levels of aggregate output (income). First, consider $Y = 800$. Is this an equilibrium output? Clearly, it is not. At $Y = 800$, consumers are only interested in buying 700 worth of goods, which when added to planned inventory gives us planned aggregate expenditure levels of 725 (see Table 8.1). This amount is less than aggregate output, which is 800. Output is greater than planned spending, so the difference ends up in inventory as unplanned inventory investment. In this case, unplanned inventory investment is 75. In the aggregate, firms have more inventory than desired. As a result, firms have an incentive to change their production plans going forward. In this sense, the economy will not be in equilibrium.

Next, consider $Y = 200$. Is this an equilibrium output? No. At $Y = 200$, planned aggregate expenditure is 275. Planned spending (AE) is greater than output (Y), and there is an unplanned fall in inventory investment of 75. Again, firms in the aggregate will experience a different result from what they expected.

At $Y = 200$ and $Y = 800$, planned investment and actual investment are unequal. There is unplanned investment, and the system is out of balance. Only at $Y = 500$, where planned aggregate expenditure and aggregate output are equal, will planned investment equal actual investment.

Finally, let us find the equilibrium level of output (income) algebraically. Recall that we know the following:

$$\begin{aligned} Y &= C + I && \text{(equilbrium)} \\ C &= 100 + 0.75Y && \text{(consumption function)} \\ I &= 25 && \text{(planned investment)} \end{aligned}$$

By substituting the second and third equations into the first, we get:

$$Y = \underbrace{100 + 0.75Y}_{C} + \underbrace{25}_{I}.$$

There is only one value of Y for which this statement is true, and we can find it by rearranging terms:

$$\begin{aligned} Y - 0.75Y &= 100 + 25 \\ 0.25Y &= 125 \\ Y &= \frac{125}{0.25} = 500 \end{aligned}$$

The equilibrium level of output is 500, as shown in Table 8.1 and Figure 8.6.

The Saving/Investment Approach to Equilibrium MyLab Economics Concept Check

Aggregate income must be saved or spent, by definition, $Y \equiv C + S$, which is an identity. The equilibrium condition is $Y = C + I$, but this is not an identity because it does not hold when we are out of equilibrium.[3] By substituting $C + S$ for Y in the equilibrium condition, we can write:

$$C + S = C + I$$

We can subtract C from both sides of this equation and we are left with:

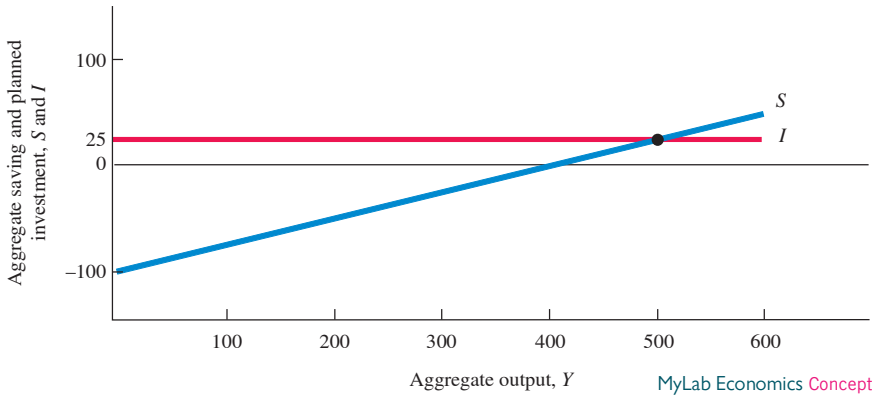
$$S = I$$

Thus, only when planned investment equals saving will there be equilibrium.

Figure 8.7 reproduces the saving schedule derived in Figure 8.4 and the horizontal investment function from Figure 8.6. Notice that $S = I$ at one and only one level of aggregate output, $Y = 500$. At $Y = 500$, $C = 475$ and $I = 25$. At this level of Y, saving equals 25 and so $S = I$ and we are at an equilibrium.

[3]It would be an identity if I included unplanned inventory accumulations—in other words, if I were actual investment instead of planned investment.

FIGURE 8.7 The $S = I$ Approach to Equilibrium
Aggregate output is equal to planned aggregate expenditure only when saving equals planned investment ($S = I$). Saving and planned investment are equal at $Y = 500$.



MyLab Economics Concept Check

Adjustment to Equilibrium MyLab Economics Concept Check

We have defined equilibrium and learned how to find it, but we have said nothing about how firms might react to *disequilibrium*. Let us consider the actions firms might take when planned aggregate expenditure exceeds aggregate output (income).

We already know the only way firms can sell more than they produce is by selling some inventory. This means that when planned aggregate expenditure exceeds aggregate output, unplanned inventory reductions have occurred. Firms have sold more than they planned. It seems reasonable to assume that firms will respond to unplanned inventory reductions by increasing output. If firms increase output, income must also increase. (Output and income are two ways of measuring the same thing.) As GM builds more cars, it hires more workers (or pays its existing workforce for working more hours), buys more steel, uses more electricity, and so on. These purchases by GM represent income for the producers of labor, steel, electricity, and so on. When firms try to keep their inventories stable by increasing production, this will generate more income in the economy as a whole. This will lead to more consumption. Remember, when income rises, so does consumption, albeit not one for one. The adjustment process will continue as long as output (income) is below planned aggregate expenditure. If firms react to unplanned inventory reductions by increasing output, an economy with planned spending greater than output will adjust to equilibrium, with Y being higher than before.

If planned spending is less than output, there will be unplanned increases in inventories. In this case, firms will respond by reducing output. As output falls, income falls, consumption falls because consumption depends on income, output falls even more, and so on, until equilibrium is restored, with Y being lower than before.

As Figure 8.6 shows, at any level of output above $Y = 500$, such as $Y = 800$, output will fall until it reaches equilibrium at $Y = 500$, and at any level of output below $Y = 500$, such as $Y = 200$, output will rise until it reaches equilibrium at $Y = 500$.[4]

8.5 LEARNING OBJECTIVE

Describe the multiplier process and use the multiplier equation to calculate changes in equilibrium.

The Multiplier

We are now ready to answer the question posed at the beginning of this chapter: what happens to the level of real output if all of the managers in the economy suddenly decide to increase planned investment from, say, 25 to 50? It may surprise you to learn that the change in equilibrium output will be *greater* than the initial change in planned investment. In fact, output will change by a multiple of the change in planned investment.

[4]In discussing simple supply and demand equilibrium in Chapters 3 and 4, we saw that when quantity supplied exceeds quantity demanded, the price falls and the quantity supplied declines. Similarly, when quantity demanded exceeds quantity supplied, the price rises and the quantity supplied increases. In the analysis here, we are ignoring potential changes in prices or in the price level and focusing on changes in the level of real output (income). Later, after we have introduced the price level into the analysis, prices will be important. At this stage, however, only aggregate output (income) (Y) adjusts when aggregate expenditure exceeds aggregate output (with inventory falling) or when aggregate output exceeds aggregate expenditure (with inventory rising).

ECONOMICS IN PRACTICE

The Rise and Fall of Nokia

As we will see, an unplanned increase in inventory is likely to reduce output by a larger proportion than the reduction in investment expenditure. This can have pronounced effects on the overall level of output, especially for large industries that have a significant contribution to their country's GDP. Let us take the example of the Finnish company Nokia. Up until 2007, the mogul mobile phone producer supplied nearly 48 percent of the world's mobile phones. At the national level, it accounted for 4 percent of Finland's GDP, 21 percent of total exports, and 14 percent of corporate tax revenues.[1]

However, Nokia's fortune reversed in 2007 with the advent of Apple's iPhone and other Android devices. The decrease in global demand resulted in a disequilibrium due to the accumulation of unplanned inventory. Nokia responded by massive production cutbacks and several rounds of immense layoffs. This decline in production slashed its global market share from 46.7 percent in 2007 to a mere 1 percent in 2017. Further, its share of market capital in Helsinki's stock exchange plunged from 70 percent to 13 percent during the same period.

As for backward linkages, since many industries, such as electronics manufacturing, research and development, software, wholesalers, and retailers, depended on Nokia, the impact on the Finnish economy was immense. Studies show that at least 20 percent of the reduction of total employment between 2008 and 2016 is attributed to the "Nokia effect," while the rest is due to the Global Financial Crisis of 2008. The prolonged structural unemployment and collapsing household incomes that followed caused an economic slowdown. By 2016, Nokia was contributing to less than 0.4 percent of Finland's gross GDP.[2]

The takeaway from this case is that a nation's dependence on a single company or industry can be quite risky because, in the event of corporate mismanagement or market failure,

it can cause severe macroeconomic damage. Therefore, diversification is key in a nation's industrial policy to protect the economy from shifts in technology, swings in consumer behavior, changes in competitive advantage, or economic meltdowns.

CRITICAL THINKING

1. Do you think that during its golden years from 1998 to 2007, Nokia had unplanned inventory levels? How would this have impacted the overall level of Finland's GDP?

[1]Boston Consulting Group, 2017. "Nokia: Reprogramming for Growth," *The Comeback Kids: Lessons from Successful Turnarounds*, November 13.
[2]Paavo Suni and Vesa Vihriälä, 2016. "Finland and Its Northern Peers in the Great Recession." ETLA Reports No. 49, The Research Institute of the Finnish Economy–ELTA, January 15.

The **multiplier** is defined as the ratio of the change in the equilibrium level of output to a change in some exogenous variable. An **exogenous variable** is a variable that does not depend on the state of the economy—that is, a variable is exogenous if it does not change in response to changes in the economy. In this chapter, we treat planned investment as exogenous. This simplifies our analysis and provides a foundation for later discussions.

multiplier The ratio of the change in the equilibrium level of output to a change in some exogenous variable.

exogenous variable A variable that is assumed not to depend on the state of the economy—that is, it does not change when the economy changes.

With planned investment exogenous, we can ask how much the equilibrium level of output changes when planned investment changes. Remember that we are not trying to explain *why* planned investment changes; we are simply asking how much the equilibrium level of output changes when (for whatever reason) planned investment changes. (Beginning in Chapter 11, we will no longer take planned investment as a given and will explain how planned investment is determined.)

Consider a sustained increase in planned investment of 25—that is, suppose I increases from 25 to 50 and stays at 50. If equilibrium existed at $I = 25$, an increase in planned investment of 25 will cause a disequilibrium, with planned aggregate expenditure greater than aggregate output by 25. Firms immediately see unplanned reductions in their inventories. As a result, firms begin to increase output.

Let us say the increase in planned investment comes from an anticipated increase in world travel that comes, for example, from a decision by a major world power to lift restrictions on its

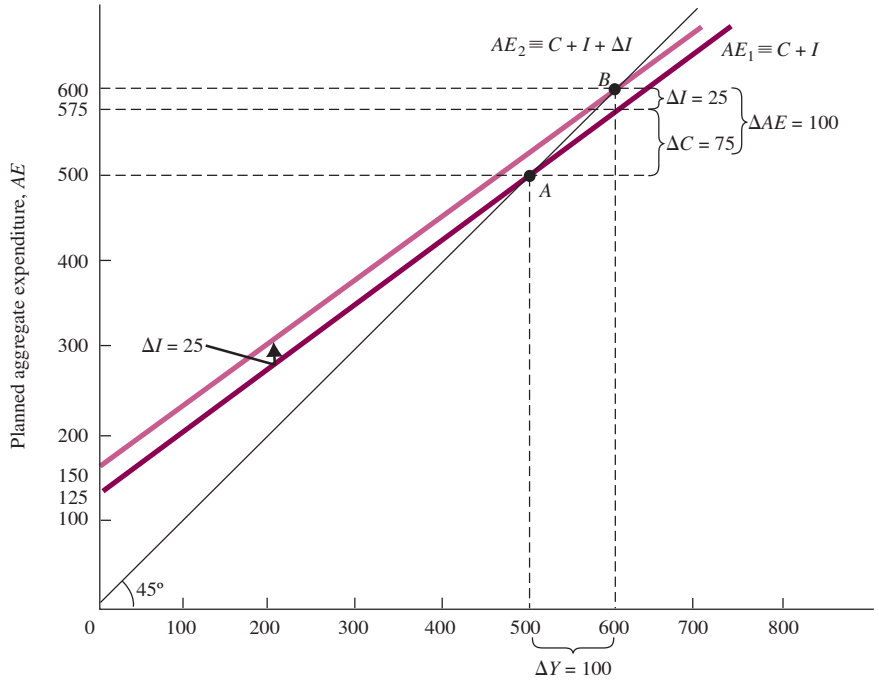
citizens' ability to travel. This increase in expected travel demand leads airlines to purchase more airplanes, car rental companies to increase purchases of automobiles, and bus companies to purchase more buses (all capital goods). The firms experiencing unplanned inventory declines will be automobile manufacturers, bus producers, and aircraft producers—GM, Ford, Boeing, and so on. In response to declining inventories of planes, buses, and cars, these firms will increase output.

Now suppose these firms raise output by the full 25 increase in planned investment. Does this restore equilibrium? No, it does not because when output goes up, people earn more income and a part of that income will be spent. This increases planned aggregate expenditure even further. In other words, an increase in *I* also leads indirectly to an increase in *C*. To produce more airplanes, Boeing has to hire more workers or ask its existing employees to work more hours. It also must buy more engines from General Electric, more tires from Goodyear, and so on. Owners of these firms will earn more profits, produce more, hire more workers, and pay out more in wages and salaries. This added income does not vanish into thin air. It is paid to households that spend some of it and save the rest. The added production leads to added income, which leads to added consumption spending.

If planned investment (*I*) goes up by 25 initially *and is sustained at this higher level*, an increase of output of 25 will *not* restore equilibrium because it generates even more consumption spending (*C*). People buy more consumer goods. There are unplanned reductions of inventories of basic consumption items—washing machines, food, clothing, and so on—and this prompts other firms to increase output. The cycle starts all over again.

Output and income can rise significantly more than the initial increase in planned investment, but how much and how large is the multiplier? This is answered graphically in Figure 8.8. Assume that the economy is in equilibrium at point *A*, where equilibrium output is 500. The increase in *I* of 25 shifts the $AE \equiv C + I$ curve up by 25 because *I* is higher by 25 at every level of income. The new equilibrium occurs at point *B*, where the equilibrium level of output is 600. Like point *A*, point *B* is on the 45-degree line and is an equilibrium value. Output (*Y*) has increased by 100 (600–500), or four times the initial increase in planned investment of 25, between point *A* and point *B*. The multiplier in this example is 4. At point *B*, aggregate spending is also higher by 100. If 25 of this additional 100 is investment (*I*), as we know it is, the remaining 75 is added consumption (*C*). From point *A* to point *B* then, $\Delta Y = 100$, $\Delta I = 25$, and $\Delta C = 75$.

FIGURE 8.8 The Multiplier as Seen in the Planned Aggregate Expenditure Diagram
At point *A*, the economy is in equilibrium at $Y = 500$. When *I* increases by 25, planned aggregate expenditure is initially greater than aggregate output. As output rises in response, additional consumption is generated, pushing equilibrium output up by a multiple of the initial increase in *I*. The new equilibrium is found at point *B*, where $Y = 600$. Equilibrium output has increased by 100 (600 − 500), or *four times* the amount of the increase in planned investment.



MyLab Economics Concept Check

Why doesn't the multiplier process go on forever? The answer is that only a fraction of the increase in income is consumed in each round. Successive increases in income become smaller and smaller in each round of the multiplier process because of leakage, such as saving, until equilibrium is restored.

The size of the multiplier depends on the slope of the planned aggregate expenditure line. The steeper the slope of this line is, the greater the change in output for a given change in investment. When planned investment is fixed, as in our example, the slope of the $AE \equiv C + I$ line is just the marginal propensity to consume $(\Delta C/\Delta Y)$. The greater the *MPC* is, the greater the multiplier. This should not be surprising. A large *MPC* means that consumption increases a great deal when income increases.

The Multiplier Equation MyLab Economics Concept Check

Is there a way to determine the size of the multiplier without using graphic analysis? Yes, there is.

Assume that the market is in equilibrium at an income level of $Y = 500$. Now suppose planned investment (I)—thus, planned aggregate expenditure (AE)—increases and remains higher by 25. Planned aggregate expenditure is greater than output, there is an unplanned inventory reduction, and firms respond by increasing output (income) (Y). This leads to a second round of increases, and so on.

What will restore equilibrium? Look at Figure 8.7 and recall: planned aggregate expenditure ($AE \equiv C + I$) is not equal to aggregate output (Y) unless $S = I$; the leakage of saving must exactly match the injection of planned investment spending for the economy to be in equilibrium. Recall also that we assumed that planned investment jumps to a new, higher level and stays there; it is a *sustained* increase of 25 in planned investment spending. As income rises, consumption rises and so does saving. Our $S = I$ approach to equilibrium leads us to conclude that equilibrium will be restored only when saving has increased by exactly the amount of the initial increase in I. Otherwise, I will continue to be greater than S and $C + I$ will continue to be greater than Y. (The $S = I$ approach to equilibrium leads to an interesting paradox in the macro-economy. See the *Economics in Practice*, "The Paradox of Thrift" on the next page.)

It is possible to figure how much Y must increase in response to the additional planned investment before equilibrium will be restored. Y will rise, pulling S up with it until the change in saving is exactly equal to the change in planned investment—that is, until S is again equal to I at its new higher level. Because added saving is a *fraction* of added income (the *MPS*), the increase in *income* required to restore equilibrium must be a *multiple* of the increase in planned investment.

Recall that the marginal propensity to save (*MPS*) is the fraction of a change in income that is saved. It is defined as the change in S (ΔS) over the change in income (ΔY):

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

Because ΔS must be equal to ΔI for equilibrium to be restored, we can substitute ΔI for ΔS and solve:

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

Therefore,

$$\Delta Y = \Delta I \times \frac{1}{MPS}$$

As you can see, the change in equilibrium income (ΔY) is equal to the initial change in planned investment (ΔI) times $1/MPS$. The multiplier is $1/MPS$:

$$\text{multiplier} \equiv \frac{1}{MPS}$$

ECONOMICS IN PRACTICE

The Paradox of Thrift

An interesting paradox can arise when households attempt to increase their saving. What happens if households become concerned about the future and want to save more today to be prepared for hard times tomorrow? If households increase their planned saving, the saving schedule in the graph below shifts upward from S_0 to S_1. The plan to save more is a plan to consume less, and the resulting drop in spending leads to a drop in income. Income drops by a multiple of the initial shift in the saving schedule. Before the increase in saving, equilibrium exists at point *A*, where $S_0 = I$ and $Y = 500$. Increased saving shifts the equilibrium to point *B*, the point at which $S_1 = I$. New equilibrium output is 300—a decrease of 200 (ΔY) from the initial equilibrium.

By consuming less, households have actually *caused* the hard times about which they were apprehensive. Worse, the new equilibrium finds saving at the same level as it was before consumption dropped (25). In their attempt to save more, households have caused a contraction in output, and thus in income. They end up consuming less, but they have not saved any more.

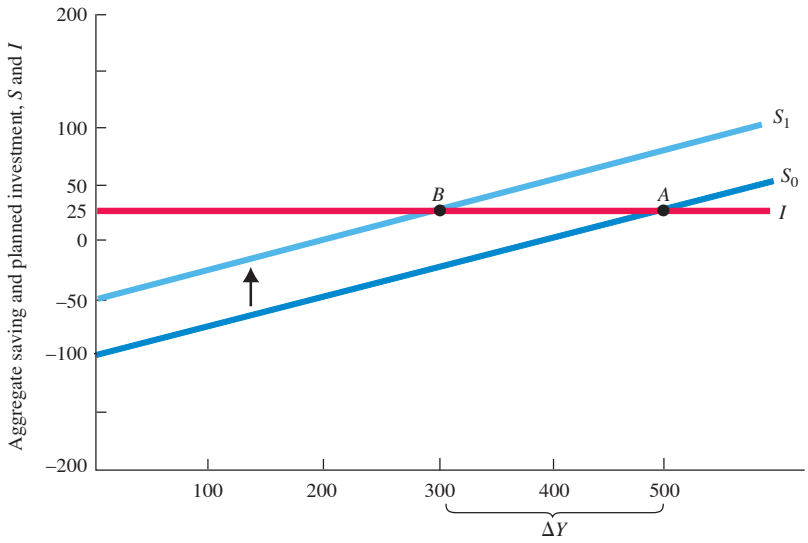
It should be clear why saving at the new equilibrium is equal to saving at the old equilibrium. Equilibrium requires that saving equals planned investment, and because planned investment is unchanged, saving must remain unchanged for equilibrium to exist. This paradox shows that the interactions among sectors in the economy can be of crucial importance.

The paradox of thrift is "paradoxical" because it contradicts the widely held belief that "a penny saved is a penny earned." This may be true for an individual, but when society as a whole saves more, the result is a drop in income, but no increased saving.

Does the paradox of thrift always hold? Recall our assumption that the interest rate is fixed. If the extra saving that the households want to do to ward off hard times leads to a fall in the interest rate, this will increase planned investment and thus shift up the *I* schedule in the figure. The paradox might then be avoided. Planned investment could increase enough so that the new equilibrium occurs at a higher level of income (and saving).

CRITICAL THINKING

1. Draw a consumption function corresponding to S_0 and S_1 and describe what is happening.



MyLab Economics Concept Check

The Paradox of Thrift

An increase in planned saving from S_0 to S_1 causes equilibrium output to decrease from 500 to 300. The decreased consumption that accompanies increased saving leads to a contraction of the economy and to a reduction of income, B=but at the new equilibrium, saving is the same as it was at the initial equilibrium. Increased efforts to save have caused a drop in income, but no overall change in saving.

Because $MPS + MPC \equiv 1$, $MPS \equiv 1 - MPC$. It follows that the multiplier is also equal to

$$\text{multiplier} \equiv \frac{1}{1 - MPC}$$

In our example, the *MPC* is .75; so the *MPS* must equal 1 – 0.75, or 0.25. Thus, the multiplier is 1 divided by .25, or 4. The change in the equilibrium level of *Y* is 4×25, or 100.[5] Also note that the same analysis holds when planned investment falls. If planned investment falls by a certain amount and is sustained at this lower level, output will fall by a multiple of the reduction in *I*. As the initial shock is felt and firms cut output, they lay people off. The result is income, and subsequently consumption, fall.

The Size of the Multiplier in the Real World MyLab Economics Concept Check

In considering the size of the multiplier, it is important to realize that the multiplier we derived in this chapter is based on a *very* simplified picture of the economy. First, we have assumed that planned investment is exogenous and does not respond to changes in the economy. Second, we have thus far ignored the role of government, financial markets, and the rest of the world in the macroeconomy. For these reasons, it would be a mistake to move on from this chapter thinking that national income can be increased by $100 billion simply by increasing planned investment spending by $25 billion. Nevertheless, even this simple model should give you some intuition as to why and how national income responds to increases in planned investment.

As we relax these assumptions in the following chapters, you will see that most of what we add to make our analysis more realistic has the effect of *reducing* the size of the multiplier. For example:

1. The Appendix to Chapter 9 shows that when tax payments depend on income (as they do in the real world), the size of the multiplier is reduced. As the economy expands, tax payments increase and act as a drag on the economy. The multiplier effect is smaller.
2. We will see in Chapter 11 that adding Fed behavior regarding the interest rate has the effect of reducing the size of the multiplier.
3. We will also see in Chapter 11 that adding the price level to the analysis reduces the size of the multiplier. We will see that part of an expansion of the economy is likely to take the form of an increase in the price level instead of an increase in real output. When this happens, the size of the multiplier is reduced.
4. The multiplier is also reduced when imports are introduced (in Chapter 19) because some domestic spending leaks into foreign markets.

These juicy tidbits give you something to look forward to as you proceed through the rest of this book. For now, however, it is enough to point out that in reality the size of the multiplier is probably about two. This is much lower than the value of four that we used in this chapter, but still tells us that an increase in planned investment has more of an effect than you might have expected before beginning this chapter!

Looking Ahead

In this chapter, we took the first step toward understanding how the economy works. We assumed that consumption depends on income, that planned investment is fixed, and that there is equilibrium. We discussed how the economy might adjust back to equilibrium when it is out of equilibrium. We also discussed the effects on equilibrium output from a change in planned investment and derived the multiplier. In the next chapter, we retain these assumptions and add the government to the economy.

[5] The multiplier can also be derived algebraically, as the Appendix to this chapter demonstrates.

SUMMARY

8.1 THE KEYNESIAN THEORY OF CONSUMPTION *p. 170*

1. Aggregate consumption is assumed to be a function of aggregate income.
2. The *marginal propensity to consume* (*MPC*) is the fraction of a change in income that is consumed, or spent. The *marginal propensity to save* (*MPS*) is the fraction of a change in income that is saved and because all income must be saved or spent, $MPS + MPC \equiv 1$.

8.2 PLANNED INVESTMENT (*I*) VERSUS ACTUAL INVESTMENT *p. 175*

3. Planned investment may differ from actual investment because of unanticipated changes in inventories.

8.3 PLANNED INVESTMENT AND THE INTEREST RATE (r) *p. 175*

4. Planned investment depends on the interest rate, which is assumed to be fixed for this chapter.

8.4 THE DETERMINATION OF EQUILIBRIUM OUTPUT (INCOME) *p. 176*

5. *Planned aggregate expenditure* (*AE*) equals consumption plus planned investment: $AE \equiv C + I$. *Equilibrium* in the goods market is achieved when planned aggregate expenditure equals aggregate output: $C + I = Y$. This holds if and only if planned investment and actual investment are equal.
6. Because aggregate income must be saved or spent, the equilibrium condition $Y = C + I$ can be rewritten as $C + S = C + I$, or $S = I$. Only when planned investment equals saving will there be equilibrium. This approach to equilibrium is the *saving/investment approach* to equilibrium.
7. When planned aggregate expenditure exceeds aggregate output (*income*), there is an unplanned fall in inventories. Firms will increase output. This increased output leads to increased income and even more consumption. This process will continue as long as output (income) is below planned aggregate expenditure. If firms react to unplanned inventory reductions by increasing output, an economy with planned spending greater than output will adjust to an equilibrium, with *Y* higher than before.

THE MULTIPLIER *p. 180*

8. Equilibrium output changes by a multiple of the change in planned investment or any other *exogenous variable*. The *multiplier* is equal to $1/MPS$.
9. When households increase their planned saving, income decreases and saving does not change. Saving does not increase because in equilibrium, saving must equal planned investment and planned investment is fixed. If planned investment also increased, this *paradox of thrift* could be averted and a new equilibrium could be achieved at a higher level of saving and income. This result depends on the existence of a channel through which additional household saving finances additional investment.

REVIEW TERMS AND CONCEPTS

actual investment *p. 175*
aggregate income *p. 170*
aggregate output *p. 170*
aggregate output (income) (*Y*), *p. 170*
aggregate saving (*S*), *p. 172*
consumption function *p. 170*
equilibrium *p. 177*
exogenous variable *p. 181*
identity *p. 172*
marginal propensity to consume (*MPC*), *p. 171*
marginal propensity to save (*MPS*), *p. 172*
multiplier *p. 181*
planned aggregate expenditure (*AE*), *p. 172*
planned investment *p. 175*
Equations: $S \equiv Y - C$, *p. 172*
$MPC \equiv$ slope of consumption function $\equiv \frac{\Delta C}{\Delta Y}$, *p. 172*
$MPC + MPS \equiv 1$, *p. 172*
$AE \equiv C + I$, *p. 177*
Equilibrium condition: $Y = AE$ *or* $Y = C + I$, *p. 177*
Saving/investment approach to equilibrium: $S = I$, *p. 179*
Multiplier $\equiv \frac{1}{MPS} \equiv \frac{1}{1 - MPC}$, *p. 185*

PROBLEMS

All problems are available on MyLab Economics.

8.1 THE KEYNESIAN THEORY OF CONSUMPTION

LEARNING OBJECTIVE: Explain the principles of the Keynesian theory of consumption.

1.1 Briefly define the following terms and explain the relationship between *MPC* and *MPS* and the relationship between aggregate output and aggregate income.
   a. *MPC*
   b. *MPS*
   c. Aggregate output
   d. Aggregate income

1.2 Fill in the aggregate saving column in the following table. Use the data in the table to calculate the consumption function and the saving function, and plot these functions

MyLab Economics Visit **www.pearson.com/mylab/economics** to complete these exercises online and get instant feedback. Exercises that update with real-time data are marked with .