
# Investment

*The social object of skilled investment should be to defeat the dark forces of time and ignorance which envelope our future.*

*—John Maynard Keynes*

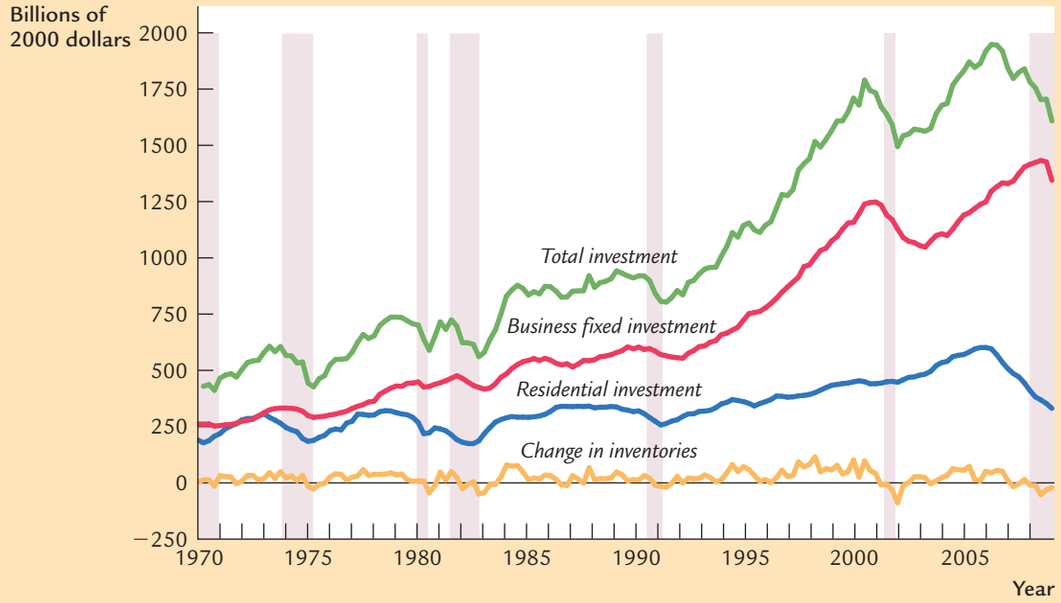
While spending on consumption goods provides utility to households today, spending on investment goods is aimed at providing a higher standard of living at a later date. Investment is the component of GDP that links the present and the future.

Investment spending plays a key role not only in long-run growth but also in the short-run business cycle because it is the most volatile component of GDP. When expenditure on goods and services falls during a recession, much of the decline is usually due to a drop in investment. In the severe U.S. recession of 1982, for example, real GDP fell $105 billion from its peak in the third quarter of 1981 to its trough in the fourth quarter of 1982. Investment spending over the same period fell $152 billion, accounting for more than the entire fall in spending.

Economists study investment to better understand fluctuations in the economy's output of goods and services. The models of GDP we saw in previous chapters, such as the *IS–LM* model in Chapters 10 and 11, were based on a simple investment function relating investment to the real interest rate: $I = I(r)$. That function states that an increase in the real interest rate reduces investment. In this chapter we look more closely at the theory behind this investment function.

There are three types of investment spending. **Business fixed investment** includes the equipment and structures that businesses buy to use in production. **Residential investment** includes the new housing that people buy to live in and that landlords buy to rent out. **Inventory investment** includes those goods that businesses put aside in storage, including materials and supplies, work in process, and finished goods. Figure 18-1 plots total investment and its three components in the United States between 1970 and 2008. You can see that all types of investment usually fall during recessions, which are shown as shaded areas in the figure.

**FIGURE 18-1**




**The Three Components of Investment** This figure shows total investment, business fixed investment, residential investment, and inventory investment in the United States from 1970 to 2008. Notice that all types of investment usually fall during recessions, which are indicated here by the shaded areas.

*Source:* U.S. Department of Commerce and Global Financial Data.

In this chapter we build models of each type of investment to explain these fluctuations. The models will shed light on the following questions:

- Why is investment negatively related to the interest rate?
- What causes the investment function to shift?
- Why does investment rise during booms and fall during recessions?

At the end of the chapter, we return to these questions and summarize the answers that the models offer.

## 18-1 Business Fixed Investment

The largest piece of investment spending, accounting for about three-quarters of the total, is business fixed investment. The term "business" means that these investment goods are bought by firms for use in future production. The term "fixed" means that this spending is for capital that will stay put for a while, as

opposed to inventory investment, which will be used or sold within a short time. Business fixed investment includes everything from office furniture to factories, computers to company cars.

The standard model of business fixed investment is called the **neoclassical model of investment.** The neoclassical model examines the benefits and costs to firms of owning capital goods. The model shows how the level of investment—the addition to the stock of capital—is related to the marginal product of capital, the interest rate, and the tax rules affecting firms.

To develop the model, imagine that there are two kinds of firms in the economy. *Production firms* produce goods and services using capital that they rent. *Rental firms* make all the investments in the economy; they buy capital and rent it out to the production firms. Most firms in the real world perform both functions: they produce goods and services, and they invest in capital for future production. We can simplify our analysis and clarify our thinking, however, if we separate these two activities by imagining that they take place in different firms.

## The Rental Price of Capital

Let's first consider the typical production firm. As we discussed in Chapter 3, this firm decides how much capital to rent by comparing the cost and benefit of each unit of capital. The firm rents capital at a rental rate $R$ and sells its output at a price $P$; the real cost of a unit of capital to the production firm is $R/P$. The real benefit of a unit of capital is the marginal product of capital $MPK$—the extra output produced with one more unit of capital. The marginal product of capital declines as the amount of capital rises: the more capital the firm has, the less an additional unit of capital will add to its output. Chapter 3 concluded that, to maximize profit, the firm rents capital until the marginal product of capital falls to equal the real rental price.

Figure 18-2 shows the equilibrium in the rental market for capital. For the reasons just discussed, the marginal product of capital determines the demand curve. The demand curve slopes downward because the marginal product of capital is low when the level of capital is high. At any point in time, the amount of capital in the economy is fixed, so the supply curve is vertical. The real rental price of capital adjusts to equilibrate supply and demand.

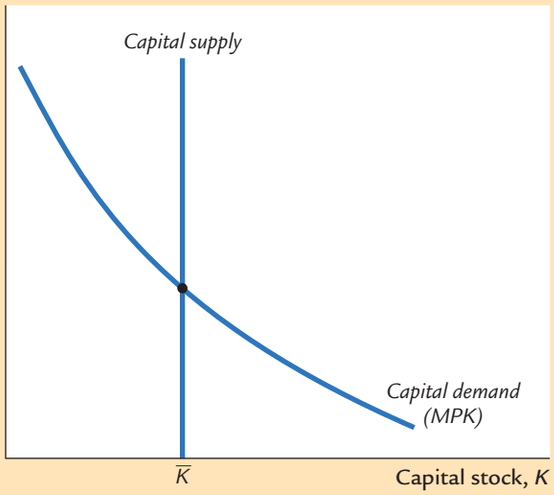
To see what variables influence the equilibrium rental price, let's consider a particular production function. As we saw in Chapter 3, many economists consider the Cobb–Douglas production function a good approximation of how the actual economy turns capital and labor into goods and services. The Cobb–Douglas production function is

$$Y = AK^{\alpha}L^{1-\alpha},$$

where $Y$ is output, $K$ is capital, $L$ is labor, $A$ is a parameter measuring the level of technology, and $\alpha$ is a parameter between zero and one that measures capital's share of output. The marginal product of capital for the Cobb–Douglas production function is

$$MPK = \alpha A(L/K)^{1-\alpha}.$$

**FIGURE 18-2**




**The Rental Price of Capital** The real rental price of capital adjusts to equilibrate the demand for capital (determined by the marginal product of capital) and the fixed supply.

Because the real rental price $R/P$ equals the marginal product of capital in equilibrium, we can write

$$R/P = \alpha A(L/K)^{1-\alpha}.$$

This expression identifies the variables that determine the real rental price. It shows the following:

- The lower the stock of capital, the higher the real rental price of capital.
- The greater the amount of labor employed, the higher the real rental price of capital.
- The better the technology, the higher the real rental price of capital.

Events that reduce the capital stock (an earthquake), or raise employment (an expansion in aggregate demand), or improve the technology (a scientific discovery) raise the equilibrium real rental price of capital.

## The Cost of Capital

Next consider the rental firms. These firms, like car-rental companies, merely buy capital goods and rent them out. Because our goal is to explain the investments made by the rental firms, we begin by considering the benefit and cost of owning capital.

The benefit of owning capital is the revenue earned by renting it to the production firms. The rental firm receives the real rental price of capital $R/P$ for each unit of capital it owns and rents out.

The cost of owning capital is more complex. For each period of time that it rents out a unit of capital, the rental firm bears three costs:

1. When a rental firm borrows to buy a unit of capital, it must pay interest on the loan. If $P_K$ is the purchase price of a unit of capital and $i$ is the nominal interest rate, then $iP_K$ is the interest cost. Notice that this interest cost would be the same even if the rental firm did not have to borrow: if the rental firm buys a unit of capital using cash on hand, it loses out on the interest it could have earned by depositing this cash in the bank. In either case, the interest cost equals $iP_K$.
2. While the rental firm is renting out the capital, the price of capital can change. If the price of capital falls, the firm loses, because the firm's asset has fallen in value. If the price of capital rises, the firm gains, because the firm's asset has risen in value. The cost of this loss or gain is $-\Delta P_K$. (The minus sign is here because we are measuring costs, not benefits.)
3. While the capital is rented out, it suffers wear and tear, called **depreciation.** If $\delta$ is the rate of depreciation—the fraction of capital's value lost per period because of wear and tear—then the dollar cost of depreciation is $\delta P_K$.

The total cost of renting out a unit of capital for one period is therefore

$$\begin{aligned}\text{Cost of Capital} &= iP_K - \Delta P_K + \delta P_K \\ &= P_K(i - \Delta P_K/P_K + \delta).\end{aligned}$$

The cost of capital depends on the price of capital, the interest rate, the rate at which capital prices are changing, and the depreciation rate.

For example, consider the cost of capital to a car-rental company. The company buys cars for \$10,000 each and rents them out to other businesses. The company faces an interest rate $i$ of 10 percent per year, so the interest cost $iP_K$ is \$1,000 per year for each car the company owns. Car prices are rising at 6 percent per year, so, excluding wear and tear, the firm gets a capital gain $\Delta P_K$ of \$600 per year. Cars depreciate at 20 percent per year, so the loss due to wear and tear $\delta P_K$ is \$2,000 per year. Therefore, the company's cost of capital is

$$\begin{aligned}\text{Cost of Capital} &= \$1{,}000 - \$600 + \$2{,}000 \\ &= \$2{,}400.\end{aligned}$$

The cost to the car-rental company of keeping a car in its capital stock is \$2,400 per year.

To make the expression for the cost of capital simpler and easier to interpret, we assume that the price of capital goods rises with the prices of other goods. In this case, $\Delta P_K/P_K$ equals the overall rate of inflation $\pi$. Because $i - \pi$ equals the real interest rate $r$, we can write the cost of capital as

$$\text{Cost of Capital} = P_K(r + \delta).$$

This equation states that the cost of capital depends on the price of capital, the real interest rate, and the depreciation rate.

Finally, we want to express the cost of capital relative to other goods in the economy. The **real cost of capital**—the cost of buying and renting out a unit of capital measured in units of the economy's output—is

$$\text{Real Cost of Capital} = (P_K/P)(r + \delta).$$

This equation states that the real cost of capital depends on the relative price of a capital good $P_K/P$, the real interest rate $r$, and the depreciation rate $\delta$.

## The Determinants of Investment

Now consider a rental firm's decision about whether to increase or decrease its capital stock. For each unit of capital, the firm earns real revenue $R/P$ and bears the real cost $(P_K/P)(r + \delta)$. The real profit per unit of capital is

$$\text{Profit Rate} = \text{Revenue} - \text{Cost}$$

$$= R/P - (P_K/P)(r + \delta).$$

Because the real rental price in equilibrium equals the marginal product of capital, we can write the profit rate as

$$\text{Profit Rate} = MPK - (P_K/P)(r + \delta).$$

The rental firm makes a profit if the marginal product of capital is greater than the cost of capital. It incurs a loss if the marginal product is less than the cost of capital.

We can now see the economic incentives that lie behind the rental firm's investment decision. The firm's decision regarding its capital stock—that is, whether to add to it or to let it depreciate—depends on whether owning and renting out capital is profitable. The change in the capital stock, called **net investment,** depends on the difference between the marginal product of capital and the cost of capital. *If the marginal product of capital exceeds the cost of capital, firms find it profitable to add to their capital stock. If the marginal product of capital falls short of the cost of capital, they let their capital stock shrink.*

We can also now see that the separation of economic activity between production and rental firms, although useful for clarifying our thinking, is not necessary for our conclusion regarding how firms choose how much to invest. For a firm that both uses and owns capital, the benefit of an extra unit of capital is the marginal product of capital, and the cost is the cost of capital. Like a firm that owns and rents out capital, this firm adds to its capital stock if the marginal product exceeds the cost of capital. Thus, we can write

$$\Delta K = I_n\,[MPK - (P_K/P)(r + \delta)],$$

where $I_n(\,)$ is the function showing how much net investment responds to the incentive to invest.

We can now derive the investment function. Total spending on business fixed investment is the sum of net investment and the replacement of depreciated capital. The investment function is

$$I = I_n\,[MPK - (P_K/P)(r + \delta)] + \delta K.$$

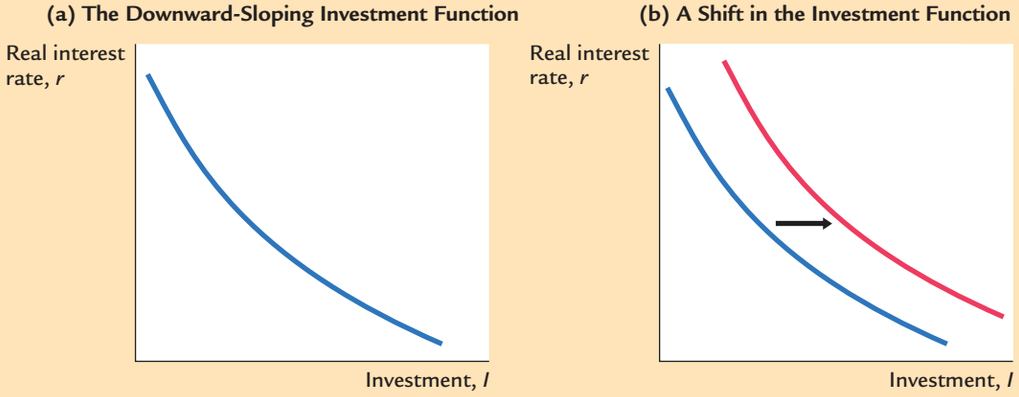
Business fixed investment depends on the marginal product of capital, the cost of capital, and the amount of depreciation.

This model shows why investment depends on the interest rate. A decrease in the real interest rate lowers the cost of capital. It therefore raises the amount of profit from owning capital and increases the incentive to accumulate more capital. Similarly, an increase in the real interest rate raises the cost of capital and leads firms to reduce their investment. For this reason, the investment schedule relating investment to the interest rate slopes downward, as in panel (a) of Figure 18-3.

The model also shows what causes the investment schedule to shift. Any event that raises the marginal product of capital increases the profitability of investment and causes the investment schedule to shift outward, as in panel (b) of Figure 18-3. For example, a technological innovation that increases the production function parameter $A$ raises the marginal product of capital and, for any given interest rate, increases the amount of capital goods that rental firms wish to buy.

Finally, consider what happens as this adjustment of the capital stock continues over time. If the marginal product begins above the cost of capital, the capital stock will rise and the marginal product will fall. If the marginal product of capital begins below the cost of capital, the capital stock will fall and the marginal

**FIGURE 18-3**




**The Investment Function** Panel (a) shows that business fixed investment increases when the interest rate falls. This is because a lower interest rate reduces the cost of capital and therefore makes owning capital more profitable. Panel (b) shows an outward shift in the investment function, which might be due to an increase in the marginal product of capital.

product will rise. Eventually, as the capital stock adjusts, the marginal product of capital approaches the cost of capital. When the capital stock reaches a steady-state level, we can write

$$MPK = (P_K/P)(r + \delta).$$

Thus, in the long run, the marginal product of capital equals the real cost of capital. The speed of adjustment toward the steady state depends on how quickly firms adjust their capital stock, which in turn depends on how costly it is to build, deliver, and install new capital.[1]

## Taxes and Investment

Tax laws influence firms' incentives to accumulate capital in many ways. Sometimes policymakers change the tax code to shift the investment function and influence aggregate demand. Here we consider two of the most important provisions of corporate taxation: the corporate income tax and the investment tax credit.

The **corporate income tax** is a tax on corporate profits. Throughout much of its history, the corporate tax rate in the United States was 46 percent. The rate was lowered to 34 percent in 1986 and then raised to 35 percent in 1993, and it remained at that level as of 2009, when this book was going to press.

The effect of a corporate income tax on investment depends on how the law defines "profit" for the purpose of taxation. Suppose, first, that the law defined profit as we did previously—the rental price of capital minus the cost of capital. In this case, even though firms would be sharing a fraction of their profits with the government, it would still be rational for them to invest if the rental price of capital exceeded the cost of capital and to disinvest if the rental price fell short of the cost of capital. A tax on profit, measured in this way, would not alter investment incentives.

Yet, because of the tax law's definition of profit, the corporate income tax does affect investment decisions. There are many differences between the law's definition of profit and ours. For example, one difference is the treatment of depreciation. Our definition of profit deducts the *current* value of depreciation as a cost. That is, it bases depreciation on how much it would cost today to replace worn-out capital. By contrast, under the corporate tax laws, firms deduct depreciation using *historical* cost. That is, the depreciation deduction is based on the price of the capital when it was originally purchased. In periods of inflation, replacement cost is greater than historical cost, so the corporate tax tends to understate the cost of depreciation and overstate profit. As a result, the tax law sees a profit and levies a tax even when economic profit is zero, which makes owning capital less attractive. For this and other reasons, many economists believe that the corporate income tax discourages investment.

Policymakers often change the rules governing the corporate income tax in an attempt to encourage investment or at least mitigate the disincentive the tax

[1] Economists often measure capital goods in units such that the price of 1 unit of capital equals the price of 1 unit of other goods and services ($P_K = P$). This was the approach taken implicitly in Chapters 7 and 8, for example. In this case, the steady-state condition says that the marginal product of capital net of depreciation, $MPK - \delta$, equals the real interest rate $r$.

provides. One example is the **investment tax credit,** a tax provision that reduces a firm's taxes by a certain amount for each dollar spent on capital goods. Because a firm recoups part of its expenditure on new capital in lower taxes, the credit reduces the effective purchase price of a unit of capital $P_K$. Thus, the investment tax credit reduces the cost of capital and raises investment.

In 1985 the investment tax credit was 10 percent. Yet the Tax Reform Act of 1986, which reduced the corporate income tax rate, also eliminated the investment tax credit. When Bill Clinton ran for president in 1992, he campaigned on a platform of reinstituting the investment tax credit, but he did not succeed in getting this proposal through Congress. Many economists agreed with Clinton that the investment tax credit is an effective way to stimulate investment, and the idea of reinstating the investment tax credit still arises from time to time.

The tax rules regarding depreciation are another example of how policymakers can influence the incentives for investment. When George W. Bush became president, the economy was sliding into recession, attributable in large measure to a significant decline in business investment. The tax cuts Bush signed into law during his first term included provisions for temporary "bonus depreciation." This meant that for purposes of calculating their corporate tax liability, firms could deduct the cost of depreciation earlier in the life of an investment project. This bonus, however, was available only for investments made before the end of 2004. The goal of the policy was to encourage investment at a time when the economy particularly needed a boost to aggregate demand. According to a recent study by economists Christopher House and Matthew Shapiro, the goal was achieved to some degree. They write, "While their aggregate effects were probably modest, the 2002 and 2003 bonus depreciation policies had noticeable effects on the economy. For the U.S. economy as a whole, these policies may have increased GDP by $10 to $20 billion and may have been responsible for the creation of 100,000 to 200,000 jobs."[2]

## The Stock Market and Tobin's *q*

Many economists see a link between fluctuations in investment and fluctuations in the stock market. The term **stock** refers to shares in the ownership of corporations, and the **stock market** is the market in which these shares are traded. Stock prices tend to be high when firms have many opportunities for profitable investment, because these profit opportunities mean higher future income for the shareholders. Thus, stock prices reflect the incentives to invest.

The Nobel Prize–winning economist James Tobin proposed that firms base their investment decisions on the following ratio, which is now called **Tobin's** *q:*

$$q = \frac{\text{Market Value of Installed Capital}}{\text{Replacement Cost of Installed Capital}}.$$

[2] A classic study of how taxes influence investment is Robert E. Hall and Dale W. Jorgenson, "Tax Policy and Investment Behavior," *American Economic Review* 57 (June 1967): 391–414. For a study of the recent corporate tax changes, see Christopher L. House and Matthew D. Shapiro, "Temporary Investment Tax Incentives: Theory with Evidence from Bonus Depreciation," NBER Working Paper No. 12514, 2006.

The numerator of Tobin's $q$ is the value of the economy's capital as determined by the stock market. The denominator is the price of that capital if it were purchased today.

Tobin reasoned that net investment should depend on whether $q$ is greater or less than 1. If $q$ is greater than 1, then the stock market values installed capital at more than its replacement cost. In this case, managers can raise the market value of their firms' stock by buying more capital. Conversely, if $q$ is less than 1, the stock market values capital at less than its replacement cost. In this case, managers will not replace capital as it wears out.

At first the $q$ theory of investment may appear very different from the neoclassical model developed previously, but the two theories are closely related. To see the relationship, note that Tobin's $q$ depends on current and future expected profits from installed capital. If the marginal product of capital exceeds the cost of capital, then firms are earning profits on their installed capital. These profits make the firms more desirable to own, which raises the market value of these firms' stock, implying a high value of $q$. Similarly, if the marginal product of capital falls short of the cost of capital, then firms are incurring losses on their installed capital, implying a low market value and a low value of $q$.

The advantage of Tobin's $q$ as a measure of the incentive to invest is that it reflects the expected future profitability of capital as well as the current profitability. For example, suppose that Congress legislates a reduction in the corporate income tax beginning next year. This expected fall in the corporate tax means greater profits for the owners of capital. These higher expected profits raise the value of stock today, raise Tobin's $q$, and therefore encourage investment today. Thus, Tobin's $q$ theory of investment emphasizes that investment decisions depend not only on current economic policies but also on policies expected to prevail in the future.[3]

CASE STUDY

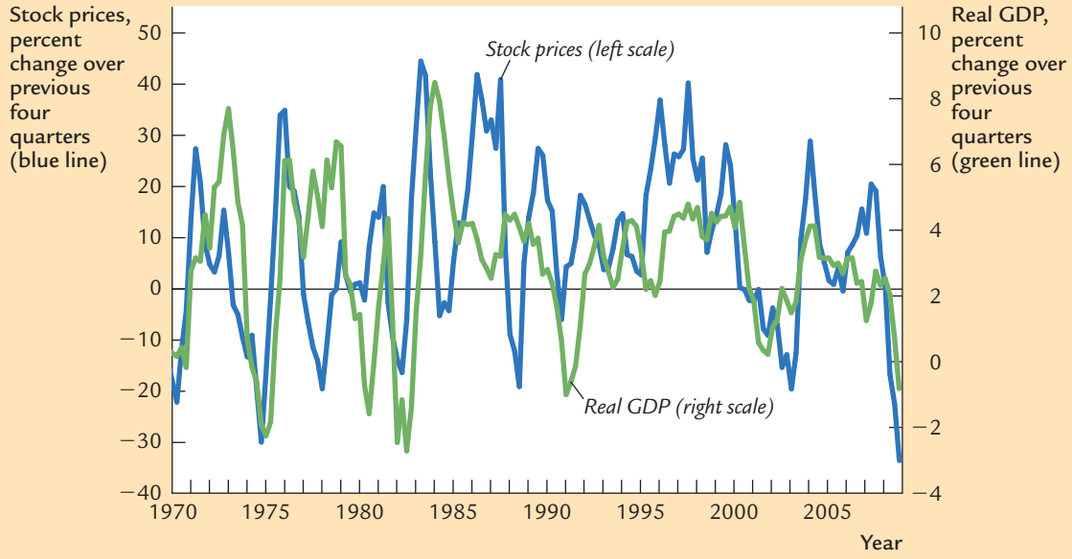
## The Stock Market as an Economic Indicator

"The stock market has predicted nine out of the last five recessions." So goes Paul Samuelson's famous quip about the stock market's reliability as an economic indicator. The stock market is in fact quite volatile, and it can give false signals about the future of the economy. Yet one should not ignore the link between the stock market and the economy. Figure 18-4 shows that changes in the stock market often reflect changes in real GDP. Whenever the stock market experiences a substantial decline, there is reason to fear that a recession may be around the corner.

Why do stock prices and economic activity tend to fluctuate together? One reason is given by Tobin's $q$ theory, together with the model of aggregate demand

[3] To read more about the relationship between the neoclassical model of investment and $q$ theory, see Fumio Hayashi, "Tobin's Marginal $q$ and Average $q$: A Neoclassical Approach," *Econometrica* 50 (January 1982): 213–224; and Lawrence H. Summers, "Taxation and Corporate Investment: A $q$-Theory Approach," *Brookings Papers on Economic Activity* 1 (1981): 67–140.

FIGURE 18-4




**The Stock Market and the Economy** This figure shows the association between the stock market and real economic activity. Using quarterly data from 1970 to 2008, it presents the percentage change from one year earlier in the Dow Jones Industrial Average (an index of stock prices of major industrial companies) and in real GDP. The figure shows that the stock market and GDP tend to move together but that the association is far from precise.

*Source:* U.S. Department of Commerce and Global Financial Data.

and aggregate supply. Suppose, for instance, that you observe a fall in stock prices. Because the replacement cost of capital is fairly stable, a fall in the stock market is usually associated with a fall in Tobin's $q$. A fall in $q$ reflects investors' pessimism about the current or future profitability of capital. This means that the investment function has shifted inward: investment is lower at any given interest rate. As a result, the aggregate demand for goods and services contracts, leading to lower output and employment.

There are two additional reasons why stock prices are associated with economic activity. First, because stock is part of household wealth, a fall in stock prices makes people poorer and thus depresses consumer spending, which also reduces aggregate demand. Second, a fall in stock prices might reflect bad news about technological progress and long-run economic growth. If so, this means that the natural level of output—and thus aggregate supply—will be growing more slowly in the future than was previously expected.

These links between the stock market and the economy are not lost on policymakers, such as those at the Federal Reserve. Indeed, because the stock market often anticipates changes in real GDP, and because data on the stock market are available more quickly than data on GDP, the stock market is a closely

watched economic indicator. A case in point is the deep economic downturn in 2008 and 2009: the substantial declines in production and employment were preceded by a steep decline in stock prices. ■

## Alternative Views of the Stock Market: The Efficient Markets Hypothesis Versus Keynes's Beauty Contest

One continuing source of debate among economists is whether stock market fluctuations are rational.

Some economists subscribe to the **efficient markets hypothesis,** according to which the market price of a company's stock is the fully rational valuation of the company's value, given current information about the company's business prospects. This hypothesis rests on two foundations:

1. Each company listed on a major stock exchange is followed closely by many professional portfolio managers, such as the individuals who run mutual funds. Every day, these managers monitor news stories to try to determine the company's value. Their job is to buy a stock when its price falls below its value and to sell it when its price rises above its value.
2. The price of each stock is set by the equilibrium of supply and demand. At the market price, the number of shares being offered for sale exactly equals the number of shares that people want to buy. That is, at the market price, the number of people who think the stock is overvalued exactly balances the number of people who think it's undervalued. As judged by the typical person in the market, the stock must be fairly valued.

According to this theory, the stock market is *informationally efficient:* it reflects all available information about the value of the asset. Stock prices change when information changes. When good news about the company's prospects becomes public, the value and the stock price both rise. When the company's prospects deteriorate, the value and price both fall. But at any moment in time, the market price is the rational best guess of the company's value based on available information.

One implication of the efficient markets hypothesis is that stock prices should follow a *random walk*. This means that the changes in stock prices should be impossible to predict from available information. If, based on publicly available information, a person could predict that a stock price would rise by 10 percent tomorrow, then the stock market must be failing to incorporate that information today. According to this theory, the only thing that can move stock prices is news that changes the market's perception of the company's value. But such news must be unpredictable—otherwise, it wouldn't really be news. For the same reason, changes in stock prices should be unpredictable as well.

What is the evidence for the efficient markets hypothesis? Its proponents point out that it is hard to beat the market by buying allegedly undervalued stocks and selling allegedly overvalued stocks. Statistical tests show that stock prices are random walks, or at least approximately so. Moreover, index funds, which buy stocks from all companies in a stock market index, outperform most actively managed mutual funds run by professional money managers.

Although the efficient markets hypothesis has many proponents, some economists are less convinced that the stock market is so rational. These economists point out that many movements in stock prices are hard to attribute to news. They suggest that when buying and selling, stock investors are less focused on companies' fundamental values and more focused on what they expect other investors will later pay.

John Maynard Keynes proposed a famous analogy to explain stock market speculation. In his day, some newspapers held "beauty contests" in which the paper printed the pictures of 100 women and readers were invited to submit a list of the five most beautiful. A prize went to the reader whose choices most closely matched those of the consensus of the other entrants. A naive entrant would simply have picked the five most beautiful women in his eyes. But a slightly more sophisticated strategy would have been to guess the five women whom other people considered the most beautiful. Other people, however, were likely thinking along the same lines. So an even more sophisticated strategy would have been to try to guess who other people thought other people thought were the most beautiful women. And so on. In the end of the process, judging true beauty would be less important to winning the contest than guessing other people's opinions of other people's opinions.

Similarly, Keynes reasoned that because stock market investors will eventually sell their shares to others, they are more concerned about other people's valuation of a company than the company's true worth. The best stock investors, in his view, are those who are good at outguessing mass psychology. He believed that movements in stock prices often reflect irrational waves of optimism and pessimism, which he called the "animal spirits" of investors.

The two views of the stock market persist to this day. Some economists see the stock market through the lens of the efficient markets hypothesis. They believe fluctuations in stock prices are a rational reflection of changes in underlying economic fundamentals. Other economists, however, accept Keynes's beauty contest as a metaphor for stock speculation. In their view, the stock market often fluctuates for no good reason, and because the stock market influences the aggregate demand for goods and services, these fluctuations are a source of short-run economic fluctuations.[4]

## Financing Constraints

When a firm wants to invest in new capital—say, by building a new factory—it often raises the necessary funds in financial markets. This financing may take several forms: obtaining loans from banks, selling bonds to the public, or selling shares in future profits on the stock market. The neoclassical model assumes that if a firm is willing to pay the cost of capital, the financial markets will make the funds available.

Yet sometimes firms face **financing constraints**—limits on the amount they can raise in financial markets. Financing constraints can prevent firms from

[4] A classic reference on the efficient markets hypothesis is Eugene Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," *Journal of Finance* 25 (1970): 383–417. For the alternative view, see Robert J. Shiller, "From Efficient Markets Theory to Behavioral Finance," *Journal of Economic Perspectives* 17 (Winter 2003): 83–104.

undertaking profitable investments. When a firm is unable to raise funds in financial markets, the amount it can spend on new capital goods is limited to the amount it is currently earning. Financing constraints influence the investment behavior of firms just as borrowing constraints influence the consumption behavior of households. Borrowing constraints cause households to determine their consumption on the basis of current rather than permanent income; financing constraints cause firms to determine their investment on the basis of their current cash flow rather than expected profitability.

To see the impact of financing constraints, consider the effect of a short recession on investment spending. A recession reduces employment, the rental price of capital, and profits. If firms expect the recession to be short-lived, however, they will want to continue investing, knowing that their investments will be profitable in the future. That is, a short recession will have only a small effect on Tobin's *q*. For firms that can raise funds in financial markets, the recession should have only a small effect on investment.

Quite the opposite is true for firms that face financing constraints. The fall in current profits restricts the amount that these firms can spend on new capital goods and may prevent them from making profitable investments. Thus, financing constraints make investment more sensitive to current economic conditions.[5]

## Banking Crises and Credit Crunches

Throughout history, problems in the banking system have often coincided with downturns in economic activity. This was true, for instance, during the Great Depression of the 1930s (which we discussed in Chapter 11). Soon after the Depression's onset, many banks found themselves insolvent, as the value of their assets fell below the value of their liabilities. These banks were forced to suspend operations. Many economists believe the widespread bank failures during this period help explain the Depression's depth and persistence.

Similar patterns, although less severe, can be observed more recently. In the United States, the recession of 2008–2009 came on the heels of a widespread financial crisis that began with a downturn in the housing market (as we discussed in Chapter 11). Problems in the banking system were also part of a slump in Japan during the 1990s and of the 1997–1998 financial crises in Indonesia and other Asian economies (as we saw in Chapter 12).

Why are banking crises so often at the center of economic downturns? Banks have an important role in the economy because they allocate financial resources to their most productive uses: they serve as *intermediaries* between those people who have income they want to save and those people who have profitable investment projects but need to borrow the funds to invest. When banks become insolvent or nearly so, they are less able to serve this function. Financing constraints become more common, and some investors are forced to forgo

[5] For empirical work supporting the importance of these financing constraints, see Steven M. Fazzari, R. Glenn Hubbard, and Bruce C. Petersen, "Financing Constraints and Corporate Investment," *Brookings Papers on Economic Activity* 1 (1988): 141–195.

potentially profitable investment projects. Such an increase in financing constraints is sometimes called a *credit crunch*.

We can use the *IS–LM* model to interpret the short-run effects of a credit crunch. When some would-be investors are denied credit, the demand for investment goods falls at every interest rate. The result is a contractionary shift in the *IS* curve. This reduces aggregate demand, production, and employment.

The long-run effects of a credit crunch are best understood from the perspective of growth theory, with its emphasis on capital accumulation as a source of growth. When a credit crunch prevents some firms from investing, the financial markets fail to allocate national saving to its best use. Less productive investment projects may take the place of more productive projects, reducing the economy's potential for producing goods and services.

Because of these effects, policymakers at the Fed and other parts of government are always trying to monitor the health of the nation's banking system. Their goal is to avert banking crises and credit crunches and, when they do occur, to respond quickly to minimize the resulting disruption to the economy.

That job is not easy, as the financial crisis and economic downturn of 2008–2009 illustrates. In this case, as we discussed in Chapter 11, many banks had made large bets on the housing markets through their purchases of mortgage-backed securities. When those bets turned bad, many banks found themselves insolvent or nearly so, and bank loans became hard to come by. Bank regulators at the Federal Reserve and other government agencies, like many of the bankers themselves, were caught off guard by the magnitude of the losses and the resulting precariousness of the banking system. What kind of regulatory changes will be needed to try to reduce the likelihood of future banking crises remains a topic of active debate.

## 18-2 Residential Investment

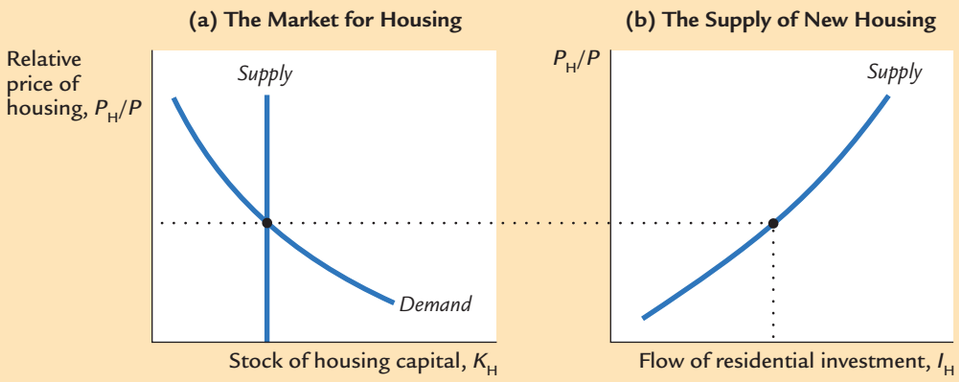
In this section we consider the determinants of residential investment. We begin by presenting a simple model of the housing market. Residential investment includes the purchase of new housing both by people who plan to live in it themselves and by landlords who plan to rent it to others. To keep things simple, however, it is useful to imagine that all housing is owner-occupied.

### The Stock Equilibrium and the Flow Supply

There are two parts to the model. First, the market for the existing stock of houses determines the equilibrium housing price. Second, the housing price determines the flow of residential investment.

Panel (a) of Figure 18-5 shows how the relative price of housing $P_H/P$ is determined by the supply and demand for the existing stock of houses. At any point in time, the supply of houses is fixed. We represent this stock with a vertical supply curve. The demand curve for houses slopes downward, because high prices cause people to live in smaller houses, to share residences, or sometimes even to become homeless. The price of housing adjusts to equilibrate supply and demand.

FIGURE 18-5




**The Determination of Residential Investment** The relative price of housing adjusts to equilibrate supply and demand for the existing stock of housing capital. The relative price then determines residential investment, the flow of new housing that construction firms build.

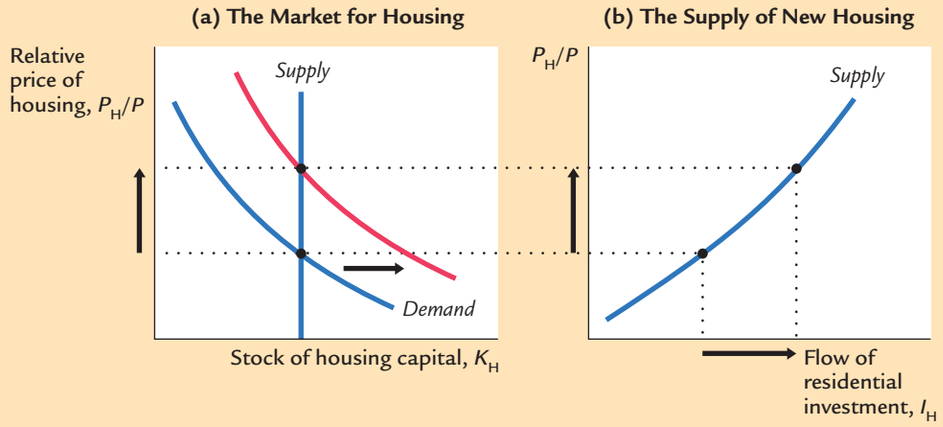
Panel (b) of Figure 18-5 shows how the relative price of housing determines the supply of new houses. Construction firms buy materials and hire labor to build houses and then sell the houses at the market price. Their costs depend on the overall price level $P$ (which reflects the cost of wood, bricks, plaster, etc.), and their revenue depends on the price of houses $P_H$. The higher the relative price of housing, the greater the incentive to build houses and the more houses are built. The flow of new houses—residential investment—therefore depends on the equilibrium price set in the market for existing houses.

This model of residential investment is similar to the $q$ theory of business fixed investment. According to the $q$ theory, business fixed investment depends on the market price of installed capital relative to its replacement cost; this relative price, in turn, depends on the expected profits from owning installed capital. According to this model of the housing market, residential investment depends on the relative price of housing. The relative price of housing, in turn, depends on the demand for housing, which depends on the imputed rent that individuals expect to receive from their housing. Hence, the relative price of housing plays much the same role for residential investment as Tobin's $q$ does for business fixed investment.

## Changes in Housing Demand

When the demand for housing shifts, the equilibrium price of housing changes, and this change in turn affects residential investment. The demand curve for housing can shift for various reasons. An economic boom raises national income and therefore the demand for housing. A large increase in the population, perhaps because of immigration, also raises the demand for housing. Panel (a) of Figure 18-6 shows that an expansionary shift in demand raises the equilibrium

FIGURE 18-6




**An Increase in Housing Demand** An increase in housing demand, perhaps attributable to a fall in the interest rate, raises housing prices and residential investment.

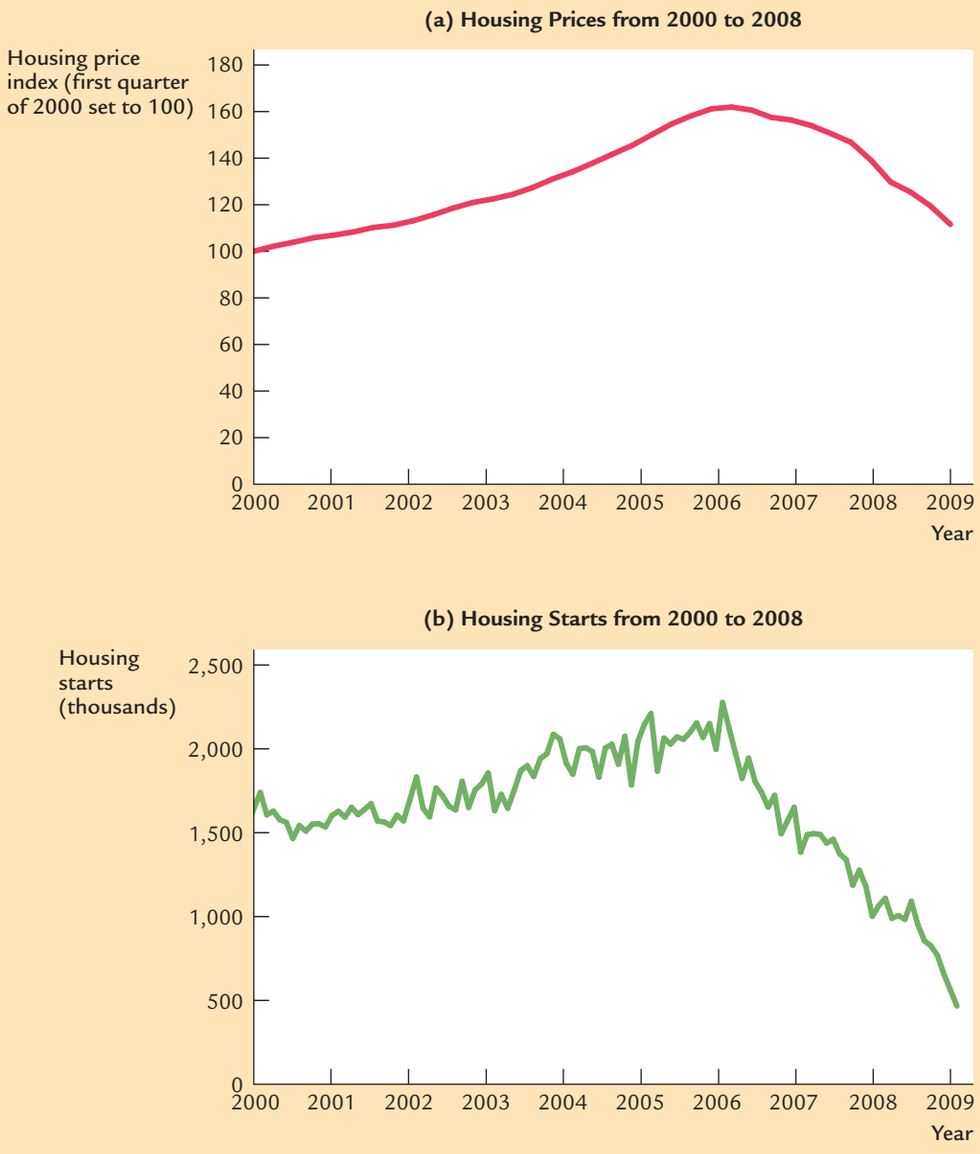
price. Panel (b) shows that the increase in the housing price increases residential investment.

One important determinant of housing demand is the real interest rate. Many people take out loans—mortgages—to buy their homes; the interest rate is the cost of the loan. Even the few people who do not have to borrow to purchase a home will respond to the interest rate, because the interest rate is the opportunity cost of holding their wealth in housing rather than putting it in a bank. A reduction in the interest rate therefore raises housing demand, housing prices, and residential investment.

Another important determinant of housing demand is credit availability. When it is easy to get a loan, more households buy their own homes, and they buy larger ones than they otherwise might, thus increasing the demand for housing. When credit conditions become tight, fewer people buy their own homes or trade up to larger ones, and the demand for housing falls.

An example of this phenomenon occurred during the first decade of the 2000s. Early in this decade, interest rates were low, and mortgages were easy to come by. Many households with questionable credit histories—called *subprime* borrowers—were able to get mortgages with small down payments. Not surprisingly, the housing market boomed. Housing prices rose, and residential investment was strong. A few years later, however, it became clear that the situation had gotten out of hand, as many of these subprime borrowers could not keep up with their mortgage payments. When interest rates rose and credit conditions tightened, housing demand and housing prices started to fall. Figure 18-7 illustrates the movement of housing prices and housing starts during this period. When the housing market turned down in 2007 and 2008, the result was a significant downturn in the overall economy, which is discussed in a Case Study in Chapter 11.

**FIGURE 18-7**




**The Housing Market from 2000 to 2008** The first decade of the 2000s began with a boom in the housing market, followed by a bust. Panel (a) shows an index of housing prices. Panel (b) shows housing starts—the number of new houses on which builders begin construction.

*Source:* House prices are the seasonally adjusted S&P/Case–Shiller nationwide index, adjusted for inflation using the GDP deflator. Housing starts are from the U.S. Department of Commerce.

## 18-3 Inventory Investment

Inventory investment—the goods that businesses put aside in storage—is at the same time negligible and of great significance. It is one of the smallest components of spending, averaging about 1 percent of GDP. Yet its remarkable volatility makes it central to the study of economic fluctuations. In recessions, firms stop replenishing their inventory as goods are sold, and inventory investment becomes negative. In a typical recession, more than half the fall in spending comes from a decline in inventory investment.

### Reasons for Holding Inventories

Inventories serve many purposes. Let's discuss in broad terms some of the motives firms have for holding inventories.

One use of inventories is to smooth the level of production over time. Consider a firm that experiences temporary booms and busts in sales. Rather than adjusting production to match the fluctuations in sales, the firm may find it cheaper to produce goods at a steady rate. When sales are low, the firm produces more than it sells and puts the extra goods into inventory. When sales are high, the firm produces less than it sells and takes goods out of inventory. This motive for holding inventories is called **production smoothing.**

A second reason for holding inventories is that they may allow a firm to operate more efficiently. Retail stores, for example, can sell merchandise more effectively if they have goods on hand to show to customers. Manufacturing firms keep inventories of spare parts to reduce the time that the assembly line is shut down when a machine breaks. In some ways, we can view **inventories as a factor of production:** the larger the stock of inventories a firm holds, the more output it can produce.

A third reason for holding inventories is to avoid running out of goods when sales are unexpectedly high. Firms often have to make production decisions before knowing the level of customer demand. For example, a publisher must decide how many copies of a new book to print before knowing whether the book will be popular. If demand exceeds production and there are no inventories, the good will be out of stock for a period, and the firm will lose sales and profit. Inventories can prevent this from happening. This motive for holding inventories is called **stock-out avoidance.**

A fourth explanation of inventories is dictated by the production process. Many goods require a number of production steps and, therefore, take time to produce. When a product is only partly completed, its components are counted as part of a firm's inventory. These inventories are called **work in process.**

### How the Real Interest Rate and Credit Conditions Affect Inventory Investment

Like other components of investment, inventory investment depends on the real interest rate. When a firm holds a good in inventory and sells it

tomorrow rather than selling it today, it gives up the interest it could have earned between today and tomorrow. Thus, the real interest rate measures the opportunity cost of holding inventories.

When the real interest rate rises, holding inventories becomes more costly, so rational firms try to reduce their stock. Therefore, an increase in the real interest rate depresses inventory investment. For example, in the 1980s many firms adopted "just-in-time" production plans, which were designed to reduce the amount of inventory by producing goods just before sale. The high real interest rates that prevailed during most of this decade are one possible explanation for this change in business strategy.

Inventory investment also depends on credit conditions. Because many firms rely on bank loans to finance their purchases of inventories, they cut back when these loans are hard to come by. During the credit crisis of 2008, for example, firms reduced their inventory holdings substantially. Real inventory investment, which had been $42 billion in 2006, fell to a negative $28 billion in 2008. As in many economic downturns, the decline in inventory investment was a key part of the decline in aggregate demand.

## 18-4 Conclusion

The purpose of this chapter has been to examine the determinants of investment in detail. Looking back on the various models of investment, we can see three themes.

First, all types of investment spending are inversely related to the real interest rate. A higher interest rate raises the cost of capital for firms that invest in plant and equipment, raises the cost of borrowing for home-buyers, and raises the cost of holding inventories. Thus, the models of investment developed here justify the investment function we have used throughout this book.

Second, there are various causes of shifts in the investment function. An improvement in the available technology raises the marginal product of capital and raises business fixed investment. An increase in the population raises the demand for housing and raises residential investment. Most important, various economic policies, such as changes in the investment tax credit and the corporate income tax, alter the incentives to invest and thus shift the investment function.

Third, it is natural to expect investment to be volatile over the business cycle, because investment spending depends on the output of the economy as well as on the interest rate. In the neoclassical model of business fixed investment, higher employment raises the marginal product of capital and the incentive to invest. Higher output also raises firms' profits and, thereby, relaxes the financing constraints that some firms face. In addition, higher income raises the demand for houses, in turn raising housing prices and residential investment. Higher output raises the stock of inventories firms wish to hold, stimulating inventory investment. Our models predict that an economic boom should stimulate investment and a recession should depress it. This is exactly what we observe.

## Summary

1. The marginal product of capital determines the real rental price of capital. The real interest rate, the depreciation rate, and the relative price of capital goods determine the cost of capital. According to the neoclassical model, firms invest if the rental price is greater than the cost of capital, and they disinvest if the rental price is less than the cost of capital.
2. Various parts of the federal tax code influence the incentive to invest. The corporate income tax discourages investment, and the investment tax credit—which has now been repealed in the United States—encourages it.
3. An alternative way of expressing the neoclassical model is to state that investment depends on Tobin's *q*, the ratio of the market value of installed capital to its replacement cost. This ratio reflects the current and expected future profitability of capital. The higher is *q*, the greater is the market value of installed capital relative to its replacement cost and the greater is the incentive to invest.
4. Economists debate whether fluctuations in the stock market are a rational reflection of companies' true value or are driven by irrational waves of optimism and pessimism.
5. In contrast to the assumption of the neoclassical model, firms cannot always raise funds to finance investment. Financing constraints make investment sensitive to firms' current cash flow.
6. Residential investment depends on the relative price of housing. Housing prices in turn depend on the demand for housing and the current fixed supply. An increase in housing demand, perhaps attributable to a fall in the interest rate, raises housing prices and residential investment.
7. Firms have various motives for holding inventories of goods: smoothing production, using them as a factor of production, avoiding stock-outs, and storing work in process. How much inventories firms hold depends on the real interest rate and on credit conditions.

### KEY CONCEPTS

Business fixed investment
Residential investment
Inventory investment
Neoclassical model of investment
Depreciation
Real cost of capital
Net investment
Corporate income tax
Investment tax credit
Stock
Stock market
Tobin's *q*
Efficient markets hypothesis
Financing constraints
Production smoothing
Inventories as a factor of production
Stock-out avoidance
Work in process

## QUESTIONS FOR REVIEW

1. In the neoclassical model of business fixed investment, under what conditions will firms find it profitable to add to their capital stock?
2. What is Tobin's *q,* and what does it have to do with investment?
3. Explain why an increase in the interest rate reduces the amount of residential investment.
4. List four reasons firms might hold inventories.

## PROBLEMS AND APPLICATIONS

1. Use the neoclassical model of investment to explain the impact of each of the following on the rental price of capital, the cost of capital, and investment.
   a. Anti-inflationary monetary policy raises the real interest rate.
   b. An earthquake destroys part of the capital stock.
   c. Immigration of foreign workers increases the size of the labor force.
2. Suppose that the government levies a tax on oil companies equal to a proportion of the value of the company's oil reserves. (The government assures the firms that the tax is for one time only.) According to the neoclassical model, what effect will the tax have on business fixed investment by these firms? What if these firms face financing constraints?
3. The *IS–LM* model developed in Chapters 10 and 11 assumes that investment depends only on the interest rate. Yet our theories of investment suggest that investment might also depend on national income: higher income might induce firms to invest more.
   a. Explain why investment might depend on national income.
   b. Suppose that investment is determined by
   $$I = \bar{I} + aY,$$
   where $a$ is a constant between zero and one, which measures the influence of national income on investment. With investment set this way, what are the fiscal-policy multipliers in the Keynesian-cross model? Explain.
   c. Suppose that investment depends on both income and the interest rate. That is, the investment function is
   $$I = \bar{I} + aY - br,$$
   where $a$ is a constant between zero and one that measures the influence of national income on investment and $b$ is a constant greater than zero that measures the influence of the interest rate on investment. Use the *IS–LM* model to consider the short-run impact of an increase in government purchases on national income $Y$, the interest rate $r$, consumption $C$, and investment $I$. How might this investment function alter the conclusions implied by the basic *IS–LM* model?
4. When the stock market crashes, as it did in October 1929 and October 1987, what influence does it have on investment, consumption, and aggregate demand? Why? How should the Federal Reserve respond? Why?
5. It is an election year, and the economy is in a recession. The opposition candidate campaigns on a platform of passing an investment tax credit, which would be effective next year after she takes office. What impact does this campaign promise have on economic conditions during the current year?
6. The United States experienced a large increase in the number of births in the 1950s. People in this baby-boom generation reached adulthood and started forming their own households in the 1970s.
   a. Use the model of residential investment to predict the impact of this event on housing prices and residential investment.
   b. For the years 1970 and 1980, compute the real price of housing, measured as the residential investment deflator divided by the GDP deflator. What do you find? Is this finding consistent with the model? (*Hint:* A good source of data is the *Economic Report of the President,* which is published annually.)
7. U.S. tax laws encourage investment in housing (such as through the deductibility of mortgage interest for purposes of computing income) and discourage investment in business capital (such as through the corporate income tax). What are the long-run effects of this policy? (*Hint:* Think about the labor market.)