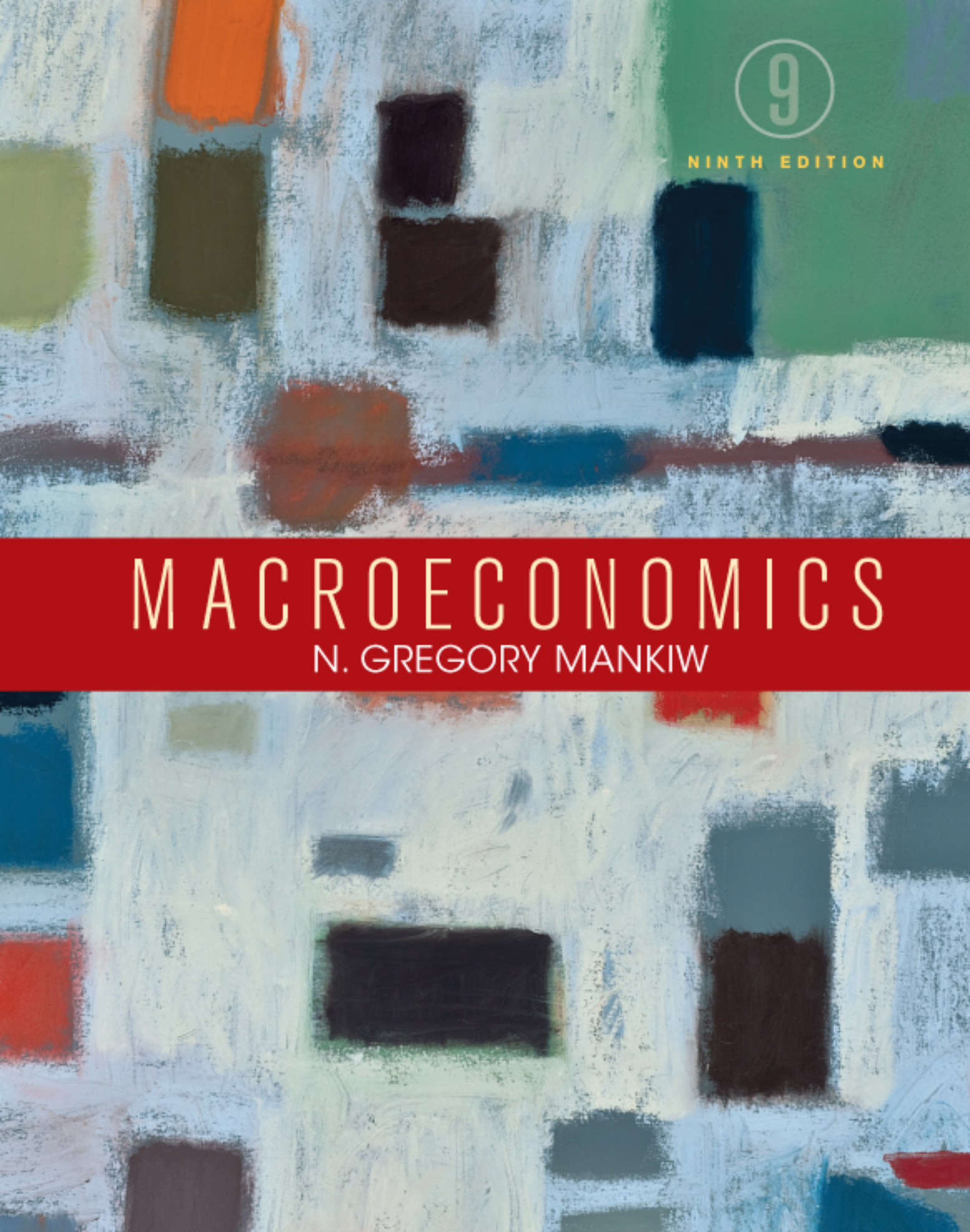
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Brief Contents

CHAPTER 17

The Theory of 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*

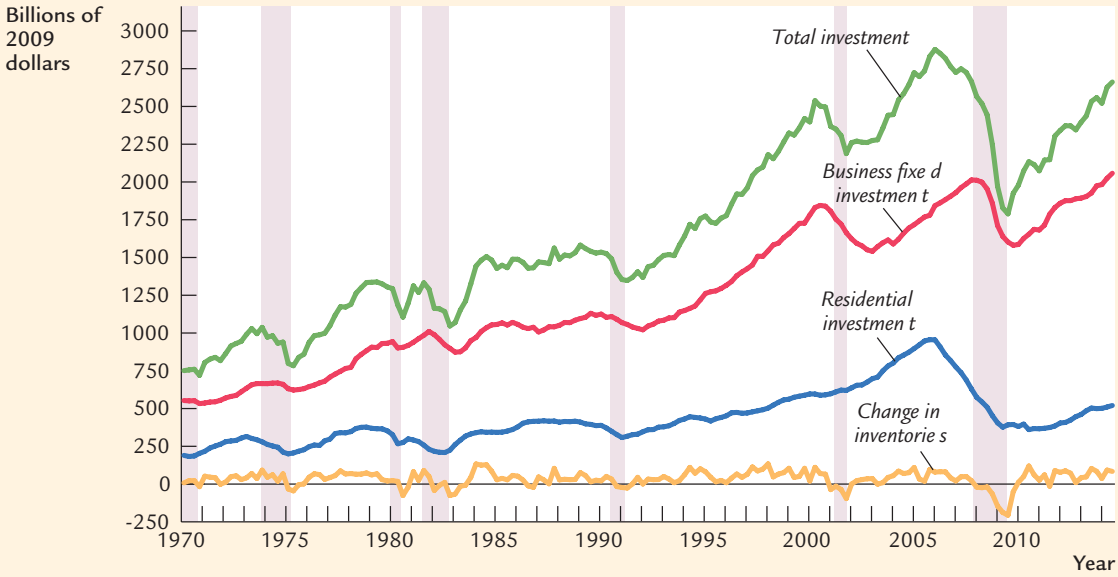
While spending on consumption goods provides utility to households today, spending on investment goods is aimed at providing a higher standard of living at a later date. Investment is the component of GDP that links the present and the future.

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 2008–2009, for example, real GDP fell $636 billion from its peak in the fourth quarter of 2007 to its trough in the second quarter of 2009. Investment spending over the same period fell $785 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 11 and 12, 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, structures, and intellectual property 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 17-1 plots total investment and its three components in the United States between 1970 and 2014. You can see that all types of investment usually fall during recessions, which are shown as shaded areas in the figure.

FIGURE 17-1



The Three Components of Investment This figure shows spending on total investment, business fixed investment, residential investment, and inventory investment in the United States from 1970 to 2014. Notice that all types of investment spending usually fall during recessions, which are indicated here by the shaded areas.

Data from: U.S. Department of Commerce. All series are adjusted for inflation using the GDP deflator.

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.

17-1 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.

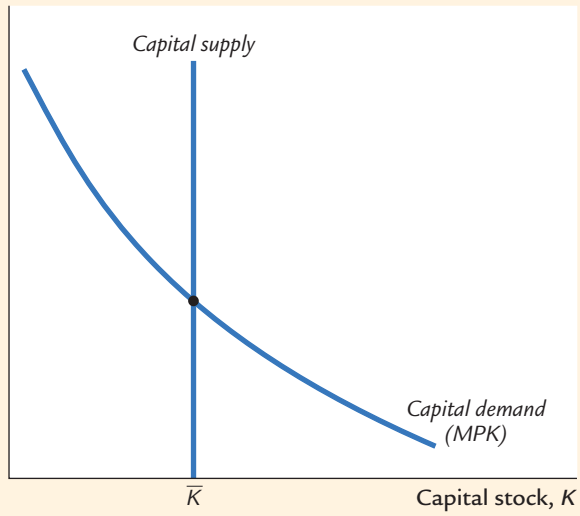
To develop the model, imagine that there are two kinds of firms in the economy. *Production firms* produce goods and services using capital that they rent. *Rental firms* make all the investments in the economy; they buy capital and rent it out to the production firms. Most firms in the real world perform 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 17-2 shows the equilibrium in the rental market for capital. For the reasons just discussed, the marginal product of capital determines the demand

FIGURE 17-2



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.

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 α 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

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

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 (a tornado), 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, 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 δ 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 δP_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 \$30,000 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 \$3,000 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 ΔP_K of \$1,800 per year. Cars depreciate at 20 percent per year, so the loss due to wear and tear δP_K is \$6,000 per year. Therefore, the company's cost of capital is

$$\begin{aligned}\text{Cost of Capital} &= \$3{,}000 - \$1{,}800 + \$6{,}000 \\ &= \$7{,}200.\end{aligned}$$

The cost to the car-rental company of keeping a car in its capital stock is \$7,200 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 π. 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 δ.

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

$$\begin{aligned}\text{Profit Rate} &= \text{Revenue} - \text{Cost}\\ &= R/P - (P_K/P)(r + \delta).\end{aligned}$$

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

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

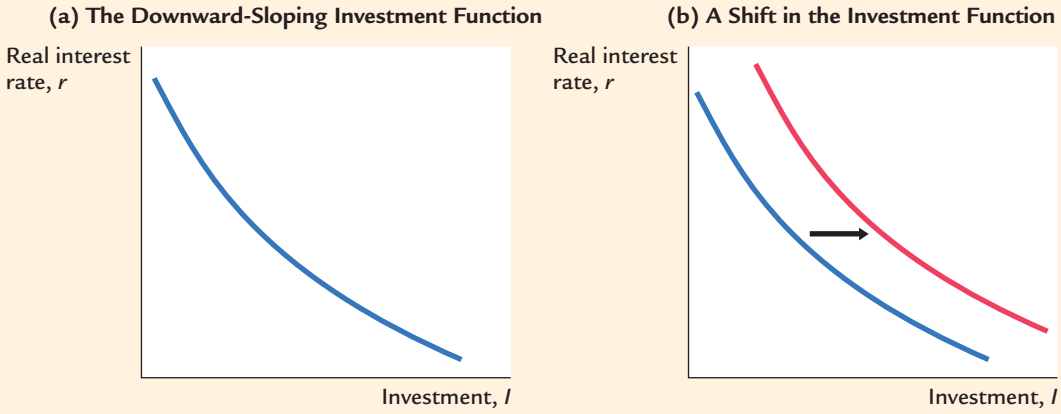
where $I_n(\,)$ is the function showing how net investment responds to the incentive to invest. How much the capital stock responds (and thus the precise form of this function) depends on how costly the adjustment process is.

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.

FIGURE 17-3



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.

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 17-3.

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 17-3. 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 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 levied by the U.S. federal government 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 2014, when this book was going to press. Many states impose an additional corporate tax as well, bringing the total corporate tax rate in the United States to about 40 percent. By contrast, the average corporate tax rate in Europe in 2014 was 19.7 percent.

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 provides. One example is the **investment tax credit**, a tax provision that

[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 8 and 9, 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.

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 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." In 2011, as the economy was in the midst of the next recession, President Obama signed into law a similar measure for temporary bonus depreciation.[2]

CASE STUDY

Inversions and Corporate Tax Reform

"Some people are calling these companies 'corporate deserters.'" That is what President Obama said in 2013 about a wave of tax inversions sweeping across corporate America, and he did not disagree with the description.

A tax inversion occurs when an American company merges with a foreign one and, in the process, reincorporates abroad. Such mergers have many motives, but often one of them is to take advantage of the more favorable tax treatment

[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," *American Economic Review* 98 (June 2008): 737–768.

offered by some other nations. Because such tax inversions mean less money for the U.S. Treasury, everyone else ends up either paying higher taxes to support the government or enjoying fewer government services. So the president had good reason to be concerned.

Yet demonizing the companies and their executives may not be the best response. A corporate chief who arranges a merger that increases the company's after-tax profit is doing her job. Forgoing that opportunity would be failing to act as a responsible fiduciary for shareholders. The great twentieth-century jurist Learned Hand put the principle this way: "Anyone may arrange his affairs so that his taxes shall be as low as possible; he is not bound to choose that pattern which best pays the treasury. There is not even a patriotic duty to increase one's taxes."

If tax inversions are a problem, perhaps the blame lies not with business leaders who are doing their jobs, but rather with a tax code that provides incentives for these inversions.

One obvious issue is that the corporate tax rate in the United States is about twice the average rate in Europe. National tax systems differ along many dimensions, making international comparisons difficult and controversial. Nonetheless, some economists suggest that simply cutting the rate to be more in line with norms abroad would do a lot to stop inversions.

A more subtle issue is that the United States has a type of corporate tax that differs from that of most nations. The United States has a *worldwide* corporate tax: for companies incorporated in the United States, the tax is based on all income, regardless of where it is earned. Most other nations have a *territorial* corporate tax: they tax economic activity that occurs within their borders and exclude from taxation income earned abroad. (That foreign-source income, however, is usually taxed by the nation where it is earned.) Canada, France, Germany, Italy, Japan, and the United Kingdom all have territorial tax systems. Again, some economists suggest that moving the U.S. tax code toward international norms would help slow corporate inversions.

If the U.S. government were to make these changes in its corporate tax, it might well collect less in tax revenue and so other taxes would need to increase to finance government spending. The debate about the corporate tax is thus intertwined with the broader debate about tax policy in general. An important principle when considering these issues is that corporations are more like tax collectors than taxpayers. The burden of the corporate tax is ultimately borne by people—some combination of the companies' employees, customers, and shareholders. After recognizing that corporations are mere conduits, policymakers can focus more directly on the people.

A long tradition in political philosophy and economics, dating back about four centuries to English philosopher Thomas Hobbes, suggests that the amount that a person consumes is the right basis for taxation. A consumption tax asks a person to contribute to support the government according to how much of the economy's output of goods and services she enjoys. Some economists have suggested scaling back the corporate income tax and replacing the lost revenue with a broad-based tax on consumption, such as a value-added tax, which many European nations use to raise government revenue.

Policymakers of many political stripes have advocated reform of the U.S. corporate tax, but the devil is in the details. Three questions loom large: To what extent should the United States cut the corporate tax rate to match rates abroad? Should the United States switch from a worldwide to a territorial system? Which other taxes should increase to make up for the lost revenue? Corporate tax reform will become possible only when policymakers agree on the answers to these key questions. ■

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***:

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

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

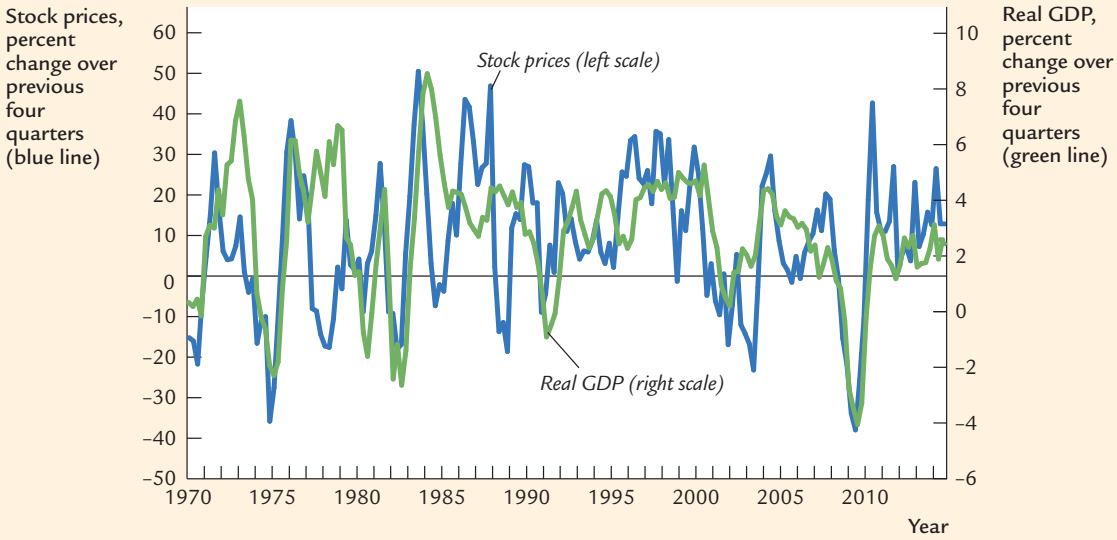
greater profits for the owners of capital. These higher expected profits raise the value of stock today, raise Tobin's q, and therefore encourage investment today. Thus, Tobin's q theory of investment emphasizes that investment decisions depend not only on current economic policies but also on policies 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 17-4 shows that changes in the stock market often reflect changes in real GDP. Whenever the stock market

FIGURE 17-4



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 2014, 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.

Data from: U.S. Department of Commerce and S&P Dow Jones Indices.

[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* 1981, no. 1: 67–140.

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 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 that 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 coincided with 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, using 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. Naive entrants would simply have picked those they considered the five most beautiful women. 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 about 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.

These 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 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.

[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.

Thus, financing constraints make investment more sensitive to current economic conditions.[5]

The extent to which financing constraints impede investment spending can vary over time, depending on the health of the financial system, and this can in turn become a source of short-run fluctuations. As we discussed in Chapter 12, for example, during the Great Depression of the 1930s, 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, making it more difficult for their previous customers to obtain financing for potential investment projects. Many economists believe the widespread bank failures during this period help explain the Depression's depth and persistence. Similarly, the severe recession of 2008–2009 came on the heels of a widespread financial crisis that began with a downturn in the housing market. Chapter 20 discusses the causes and effects of such financial crises in greater detail.

17-2 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

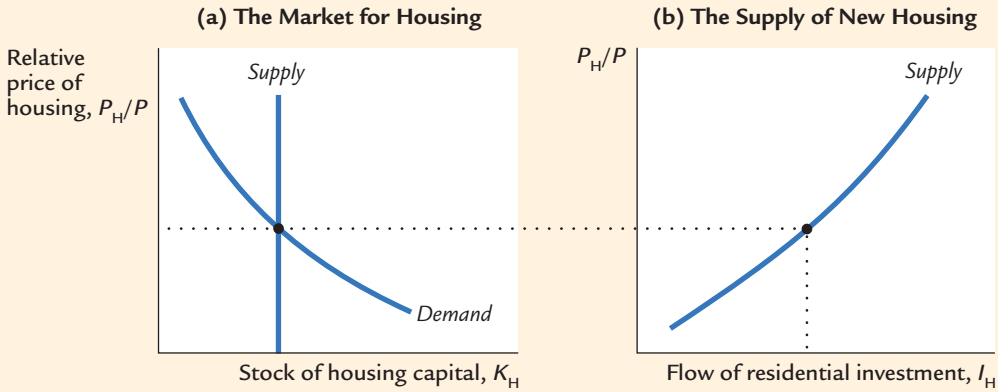
There are two parts to the model. First, the market for the existing stock of houses determines the equilibrium housing price. Second, the housing price determines the flow of residential investment.

Panel (a) of Figure 17-5 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.

Panel (b) of Figure 17-5 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,

[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* 1988, no. 1: 141–195.

FIGURE 17-5



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.

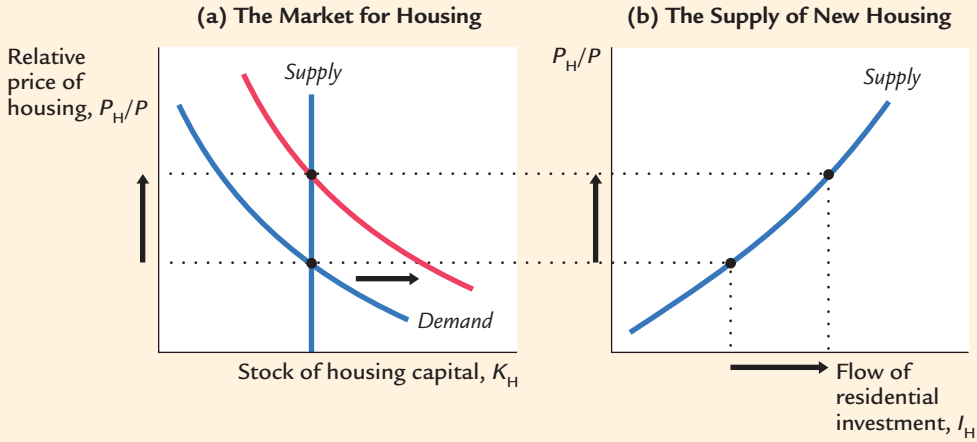
bricks, plaster, etc.), and their revenue depends on the price of houses P_H. The higher the relative price of housing, the greater the incentive to build houses and the more houses are built. The flow of new houses—residential investment—therefore depends on the equilibrium price set in the market for 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 17-6 shows that an expansionary shift in demand raises the equilibrium price. Panel (b) shows that the increase in the housing price increases residential investment.

FIGURE 17-6



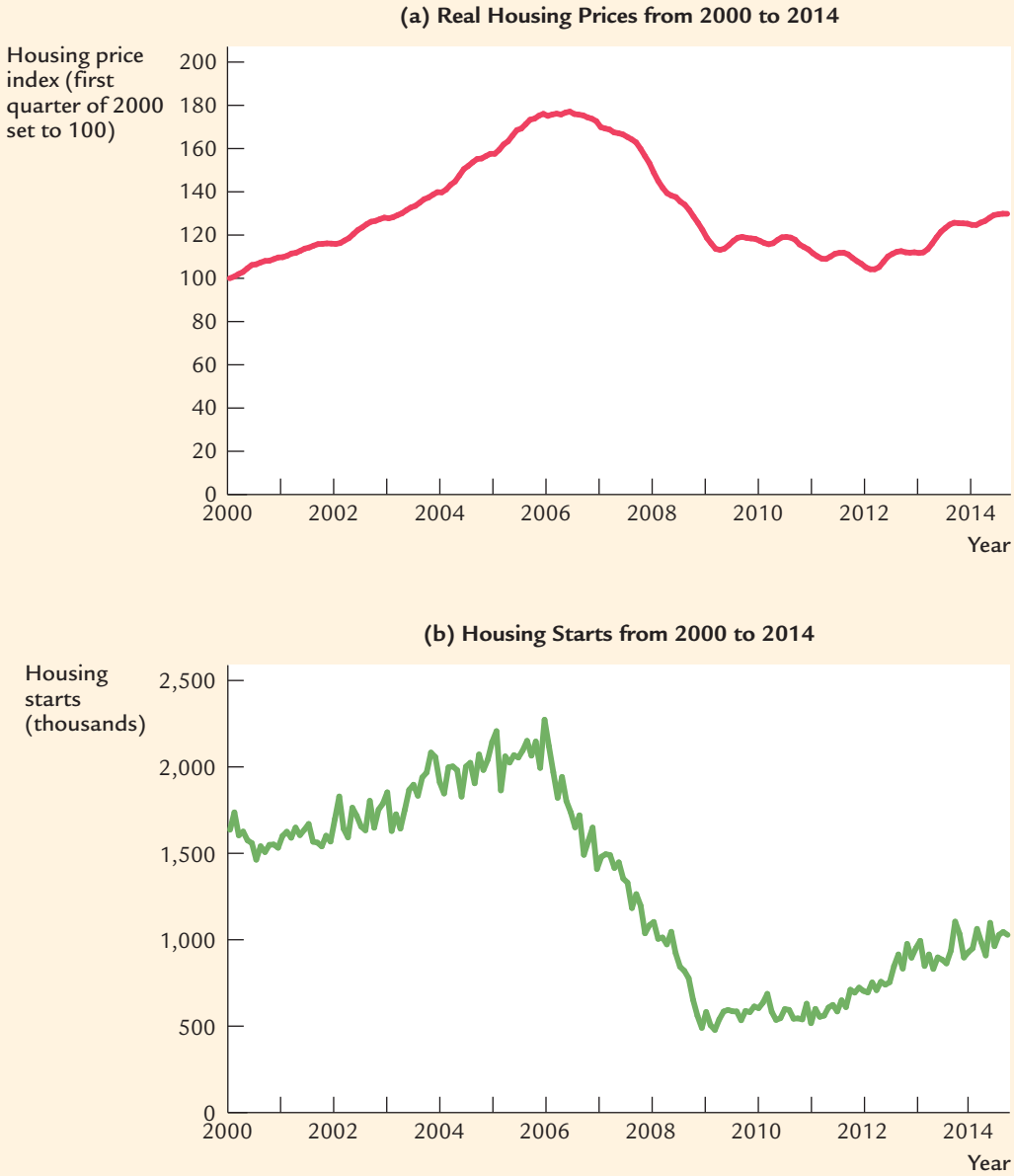
An Increase in Housing Demand An increase in housing demand, perhaps attributable to a fall in the interest rate, raises housing prices and residential investment.

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 twenty-first century. 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 17-7 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 12.

FIGURE 17-7



The Housing Market from 2000 to 2014 The first decade of the twenty-first century 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 began construction.

Data from: House prices are the seasonally adjusted prices from the S&P/Case–Shiller 20-City Composite Home Price Index, adjusted for inflation using the GDP deflator. Housing starts are from the U.S. Department of Commerce.

17-3 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 that 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 financial crisis of 2008–2009, for example, firms reduced their inventory holdings substantially. Real inventory investment, which had been $72 billion in 2006, fell to negative $34 billion in 2008 and negative $148 billion in 2009. It then returned to positive $58 billion in 2010, as the financial system and economy started to recover. During this severe recession, as in many economic downturns, the decline in inventory investment was a key part of the decline in aggregate demand.

17-4 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, various events can shift 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 availability of an investment tax credit and in 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 q is, the greater the market value of installed capital relative to its replacement cost and the greater 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.