CHAPTER

18

The Markets for the Factors of Production

When you finish school, your income will be determined largely by what kind of job you take. If you become a computer programmer, you will earn more than if you become a gas station attendant. This fact is not surprising, but it is not obvious why it is true. No law requires that computer programmers be paid more than gas station attendants. No ethical principle says that programmers are more deserving. What then determines which job will pay you the higher wage? Your income, of course, is a small piece of a larger economic picture. In 2012, the total income of all U.S. residents was about $15 trillion. People earned this income in various ways. Workers earned about two-thirds of it in the form of wages and fringe benefits. The rest went to landowners and to the owners of *capital*—the economy's stock of equipment and structures—in the form of rent, profit, and interest. What determines how much goes to workers? To landowners? To the owners of capital? Why do some workers earn higher wages than others, some landowners higher rental income than others, and

some capital owners greater profit than others? Why, in particular, do computer programmers earn more than gas station attendants?

The answers to these questions, like most in economics, hinge on supply and demand. The supply and demand for labor, land, and capital determine the prices paid to workers, landowners, and capital owners. To understand why some people have higher incomes than others, therefore, we need to look more deeply at the markets for the services they provide. That is our job in this and the next two chapters.

This chapter provides the basic theory for the analysis of factor markets. As you may recall from Chapter 2, the **factors of production** are the inputs used to produce goods and services. Labor, land, and capital are the three most important factors of production. When a computer firm produces a new software program, it uses programmers' time (labor), the physical space on which its offices are located (land), and an office building and computer equipment (capital). Similarly, when a gas station sells gas, it uses attendants' time (labor), the physical space (land), and the gas tanks and pumps (capital).

factors of production
the inputs used to produce goods and services

In many ways factor markets resemble the markets for goods and services we analyzed in previous chapters, but they are different in one important way: The demand for a factor of production is a *derived demand*. That is, a firm's demand for a factor of production is derived from its decision to supply a good in another market. The demand for computer programmers is inseparably linked to the supply of computer software, and the demand for gas station attendants is inseparably linked to the supply of gasoline.

In this chapter, we analyze factor demand by considering how a competitive, profit-maximizing firm decides how much of any factor to buy. We begin our analysis by examining the demand for labor. Labor is the most important factor of production, because workers receive most of the total income earned in the U.S. economy. Later in the chapter, we will see that our analysis of the labor market also applies to the markets for the other factors of production.

The basic theory of factor markets developed in this chapter takes a large step toward explaining how the income of the U.S. economy is distributed among workers, landowners, and owners of capital. Chapter 19 builds on this analysis to examine in more detail why some workers earn more than others. Chapter 20 examines how much income inequality results from the functioning of factor markets and then considers what role the government should and does play in altering the income distribution.

18-1 The Demand for Labor

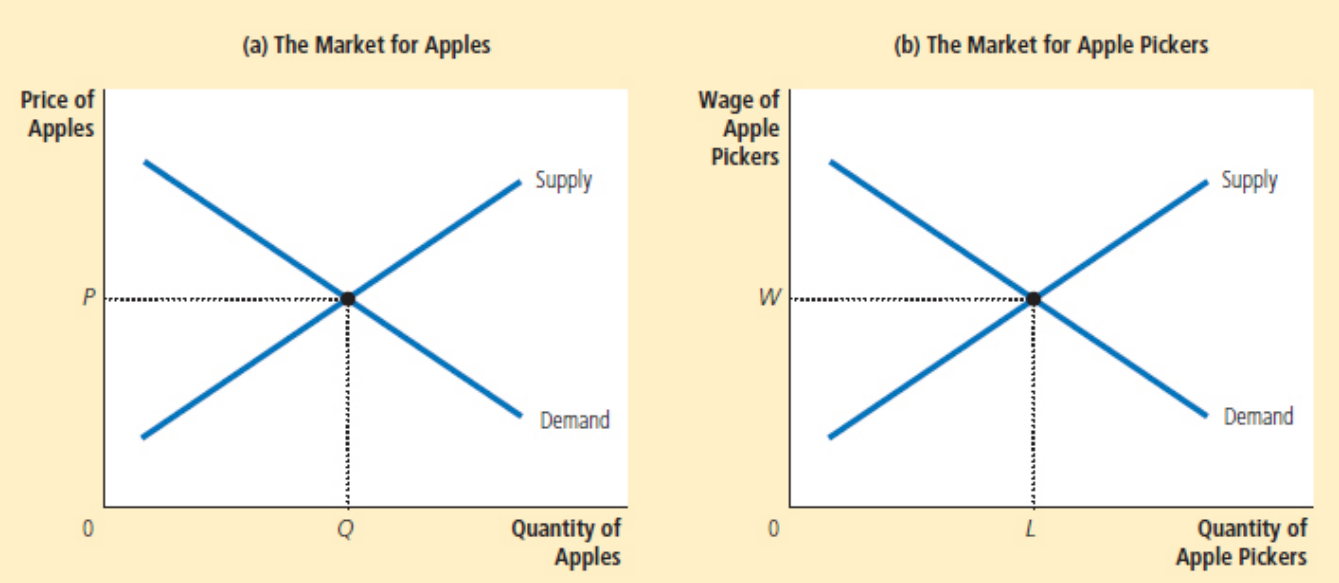
Labor markets, like other markets in the economy, are governed by the forces of supply and demand. This is illustrated in Figure 1. In panel (a), the supply and demand for apples determine the price of apples. In panel (b), the supply and demand for apple pickers determine the price, or wage, of apple pickers.

As we have already noted, labor markets are different from most other markets because labor demand is a derived demand. Most labor services, rather than being final goods ready to be enjoyed by consumers, are inputs into the production of other goods. To understand labor demand, we need to focus on the firms that hire the labor and use it to produce goods for sale. By examining the link between the production of goods and the demand for labor to make those goods, we gain insight into the determination of equilibrium wages.

FIGURE 1

The Versatility of Supply and Demand

The basic tools of supply and demand apply to goods and to labor services. Panel (a) shows how the supply and demand for apples determine the price of apples. Panel (b) shows how the supply and demand for apple pickers determine the wage of apple pickers.



18-1a The Competitive Profit-Maximizing Firm

Let's look at how a typical firm, such as an apple producer, decides what quantity of labor to demand. The firm owns an apple orchard and each week must decide how many apple pickers to hire to harvest its crop. After the firm makes its hiring decision, the workers pick as many apples as they can. The firm then sells the apples, pays the workers, and keeps what is left as profit.

We make two assumptions about our firm. First, we assume that our firm is *competitive* both in the market for apples (where the firm is a seller) and in the market for apple pickers (where the firm is a buyer). A competitive firm is a price taker. Because there are many other firms selling apples and hiring apple pickers, a single firm has little influence over the price it gets for apples or the wage it pays apple pickers. The firm takes the price and the wage as given by market conditions. It only has to decide how many apples to sell and how many workers to hire.

Second, we assume that the firm is *profit maximizing*. Thus, the firm does not directly care about the number of workers it has or the number of apples it produces. It cares only about profit, which equals the total revenue from the sale of apples minus the total cost of producing them. The firm's supply of apples and its demand for workers are derived from its primary goal of maximizing profit.

18-1b The Production Function and the Marginal Product of Labor

To make its hiring decision, the firm must consider how the size of its workforce affects the amount of

output produced. In other words, it must consider how the number of apple pickers affects the quantity of apples it can harvest and sell. Table 1 gives a numerical example. In the first column is the number of workers. In the second column is the quantity of apples the workers harvest each week.

TABLE 1

How the Competitive Firm Decides How Much Labor to Hire

Labor *L*	Output *Q*	Marginal Product of Labor *MPL* = $\Delta Q / \Delta L$	Value of the Marginal Product of Labor *VMPL* = *P* × *MPL*	Wage *W*	Marginal Profit ΔProfit = *VMPL* − *W*
0 workers	0 bushels				
		100 bushels	$1,000	$500	$500
1	100				
		80	800	500	300
2	180				
		60	600	500	100
3	240				
		40	400	500	−100
4	280				
		20	200	500	−300
5	300				

These two columns of numbers describe the firm's ability to produce. Recall that economists use the term **production function** to describe the relationship between the quantity of inputs used in production and the quantity of output from production. Here the "input" is the apple pickers and the "output" is the apples. The other inputs—the trees themselves, the land, the firm's trucks and tractors, and so on—are held fixed for now. This firm's production function shows that if the firm hires 1 worker, that worker will pick 100 bushels of apples per week. If the firm hires 2 workers, the 2 workers together will pick 180 bushels per week. And so on.

production function
the relationship between the quantity of inputs used to make a good and the quantity of output of that good

Figure 2 graphs the data on labor and output presented in Table 1. The number of workers is on the horizontal axis, and the amount of output is on the vertical axis. This figure illustrates the production function.

One of the *Ten Principles of Economics* introduced in Chapter 1 is that rational people think at the margin. This idea is the key to understanding how firms decide what quantity of labor to hire. To take a step toward this decision, the third column in Table 1 gives the **marginal product of labor**, the increase in the amount of output from an additional unit of labor. When the firm increases the number of workers from 1 to 2, for example, the amount of apples produced rises from 100 to 180 bushels. Therefore, the marginal product of the second worker is 80 bushels.

marginal product of labor
the increase in the amount of output from an additional unit of labor

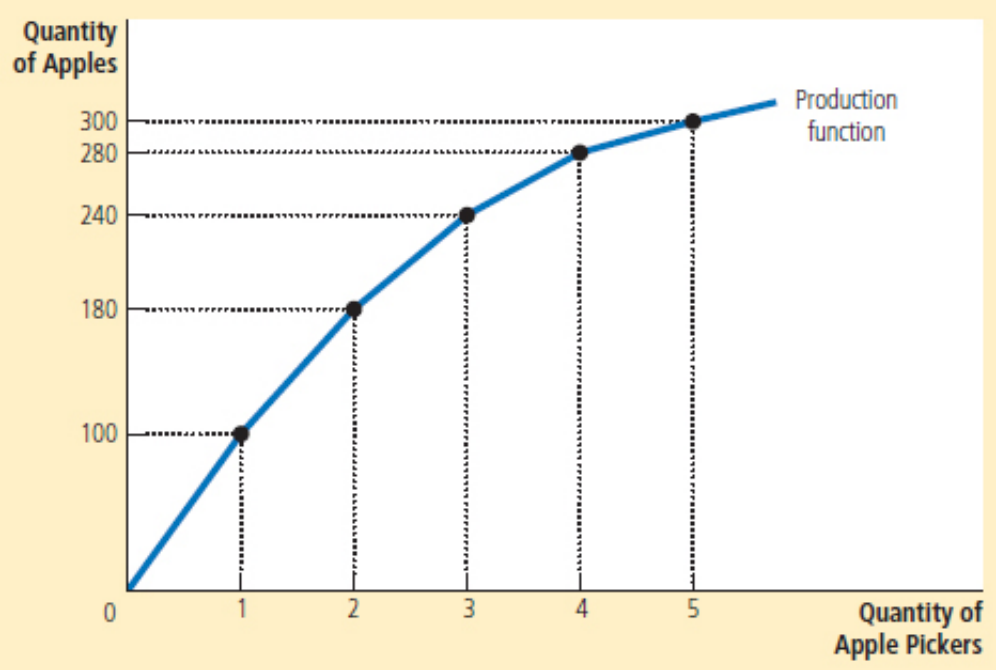
Notice that as the number of workers increases, the marginal product of labor declines. That is, the production process exhibits **diminishing marginal product**. At first, when only a few workers are hired, they can pick the low-hanging fruit. As the number of workers increases, additional workers have to climb higher up the ladders to find apples to pick. Hence, as more and more workers are hired, each additional worker contributes less to the production of apples. For this reason, the production function in Figure 2 becomes flatter as the number of workers rises.

diminishing marginal product
the property whereby the marginal product of an input declines as the quantity of the input increases

FIGURE 2

The Production Function

The production function shows how an input into production (apple pickers) influences the output from production (apples). As the quantity of the input increases, the production function gets flatter, reflecting the property of diminishing marginal product.



18-1c The Value of the Marginal Product and the Demand for Labor

Our profit-maximizing firm is concerned not about apples themselves but rather about the money it can make by producing and selling them. As a result, when deciding how many workers to hire to pick apples, the firm considers how much profit each worker would bring in. Because profit is total revenue minus total cost, the profit from an additional worker is the worker's contribution to revenue minus the worker's wage.

To find the worker's contribution to revenue, we must convert the marginal product of labor (which is measured in bushels of apples) into the *value* of the marginal product (which is measured in dollars). We do this using the price of apples. To continue our example, if a bushel of apples sells for $10 and if an additional worker produces 80 bushels of apples, then the worker produces $800 of revenue.

The **value of the marginal product** of any input is the marginal product of that input multiplied by the market price of the output. The fourth column in Table 1 shows the value of the marginal product of labor in our example, assuming the price of apples is $10 per bushel. Because the market price is constant for a competitive firm while the marginal product declines with more workers, the value of the marginal product diminishes as the number of workers rises. Economists sometimes call this column of numbers the firm's *marginal revenue product:* It is the extra revenue the firm gets from

hiring an additional unit of a factor of production.

value of the marginal product
the marginal product of an input times the price of the output

Now consider how many workers the firm will hire. Suppose that the market wage for apple pickers is $500 per week. In this case, as you can see in Table 1, the first worker that the firm hires is profitable: The first worker yields $1,000 in revenue, or $500 in profit. Similarly, the second worker yields $800 in additional revenue, or $300 in profit. The third worker produces $600 in additional revenue,

or $100 in profit. After the third worker, however, hiring workers is unprofitable. The fourth worker would yield only $400 of additional revenue. Because the worker's wage is $500, hiring the fourth worker would mean a $100 reduction in profit. Thus, the firm hires only three workers.

It is instructive to consider the firm's decision graphically. Figure 3 graphs the value of the marginal product. This curve slopes downward because the marginal product of labor diminishes as the number of workers rises. The figure also includes a horizontal line at the market wage. To maximize profit, the firm hires workers up to the point where these two curves cross. Below this level of employment, the value of the marginal product exceeds the wage, so hiring another worker would increase profit. Above this level of employment, the value of the marginal product is less than the wage, so the marginal worker is unprofitable. Thus, *a competitive, profit-maximizing firm hires workers up to the point at which the value of the marginal product of labor equals the wage*.

Having explained the profit-maximizing hiring strategy for a competitive firm, we can now offer a theory of labor demand. Recall that a firm's labor-demand curve tells us the quantity of labor that a firm demands at any given wage. We have just seen in Figure 3 that the firm makes that decision by choosing the quantity of labor at which the value of the marginal product equals the wage. As a result, *the value-of-marginal-product curve is the labor-demand curve for a competitive, profit-maximizing firm*.

18-1d What Causes the Labor-Demand Curve to Shift?

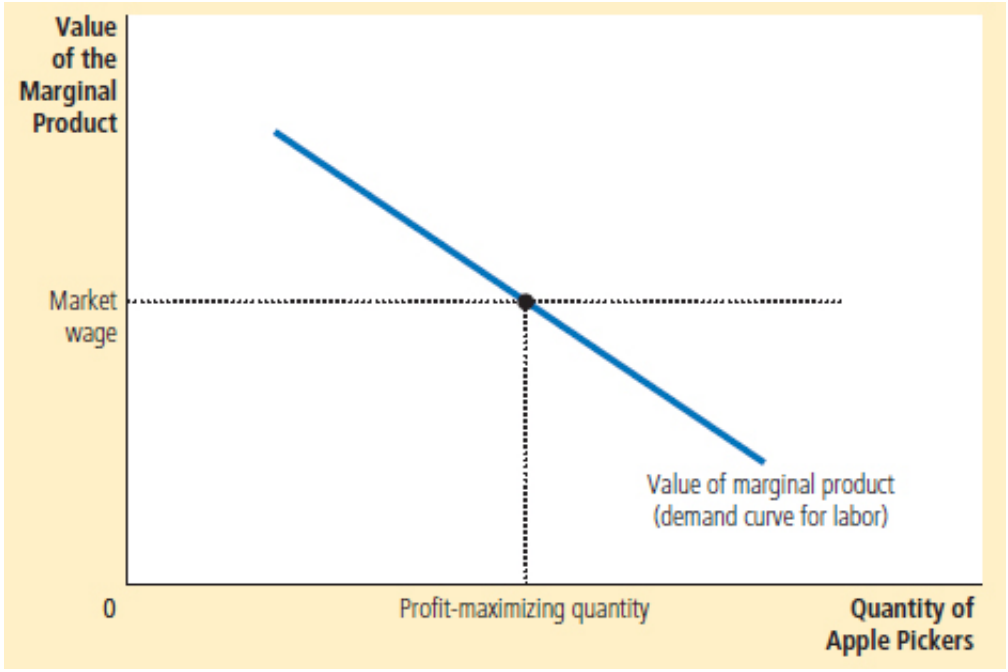
We now understand that the labor-demand curve reflects the value of the marginal product of labor. With this insight in mind, let's consider a few of the things that might cause the labor-demand curve to shift.

The Output Price The value of the marginal product is marginal product times the price of the firm's output. Thus, when the output price changes, the value of the marginal product changes, and the labor-demand curve shifts. An increase in the price of apples, for instance, raises the value of the marginal product of each worker who picks apples and, therefore, increases labor demand from the firms that supply apples. Conversely, a decrease in the price of apples reduces the value of the marginal product and decreases labor demand.

FIGURE 3

The Value of the Marginal Product of Labor

This figure shows how the value of the marginal product (the marginal product times the price of the output) depends on the number of workers. The curve slopes downward because of diminishing marginal product. For a competitive, profit-maximizing firm, this value-of-marginal-product curve is also the firm's labor-demand curve.


Value of the Marginal Product
Market wage
Value of marginal product (demand curve for labor)
0
Profit-maximizing quantity
Quantity of Apple Pickers

FYI Input Demand and Output Supply: Two Sides of the Same Coin

In Chapter 14, we saw how a competitive, profit-maximizing firm decides how much of its output to sell: It chooses the quantity of output at which the price of the good equals the marginal cost of production. We have just seen how such a firm decides how much labor to hire: It chooses the quantity of labor at which the wage equals the value of the marginal product. Because the production function links the quantity of inputs to the quantity of output, you should not be surprised to learn that the firm's decision about input demand is closely linked to its decision about output supply. In fact, these two decisions are two sides of the same coin.

To see this relationship more fully, let's consider how the marginal product of labor (*MPL*) and marginal cost (*MC*) are related. Suppose an additional worker costs $500 and has a marginal product of 50 bushels of apples. In this case, producing 50 more bushels costs $500; the marginal cost of a bushel is $500/50, or $10. More generally, if *W* is the wage, and an extra unit of labor produces *MPL* units of output, then the marginal cost of a unit of output is $MC = W/MPL$.

This analysis shows that diminishing marginal product is closely related to increasing marginal cost. When our apple orchard grows crowded with workers, each additional worker adds less to the production of apples (*MPL* falls). Similarly, when the apple firm is producing a large quantity of apples, the orchard is already crowded with workers, so it is more costly to produce an additional bushel of apples (MC rises).

Now consider our criterion for profit maximization. We determined earlier that a profit-maximizing firm chooses the quantity of labor so that the value of the marginal product ($P \times MPL$) equals the wage (*W*). We can write this mathematically as

$$P \times MPL = W.$$

If we divide both sides of this equation by *MPL*, we obtain

$$P = W/MPL.$$

We just noted that *W*/*MPL* equals marginal cost, *MC*. Therefore, we can substitute to obtain

$$P = MC.$$

This equation states that the price of the firm's output equals the marginal cost of producing a unit

of output. Thus, *when a competitive firm hires labor up to the point at which the value of the marginal product equals the wage, it also produces up to the point at which the price equals marginal cost*. Our analysis of labor demand in this chapter is just another way of looking at the production decision we first saw in Chapter 14.

Technological Change Between 1960 and 2012, the output a typical U.S. worker produced in an hour rose by 192 percent. Why? The most important reason is technological progress: Scientists and engineers are constantly figuring out new and better ways of doing things. This has profound implications for the labor market. Technological advance typically raises the marginal product of labor, which in turn increases the demand for labor and shifts the labor-demand curve to the right.

It is also possible for technological change to reduce labor demand. The invention of a cheap industrial robot, for instance, could conceivably reduce the marginal product of labor, shifting the labor-demand curve to the left. Economists call this *labor-saving* technological change. History suggests, however, that most technological progress is instead *labor-augmenting*. Such technological advance explains persistently rising employment in the face of rising wages: Even though wages (adjusted for inflation) increased by 152 percent in the last half century, firms nonetheless increased the amount of labor they employed by 88 percent.

The Supply of Other Factors The quantity available of one factor of production can affect the marginal product of other factors. A fall in the supply of ladders, for instance, will reduce the marginal product of apple pickers and thus the demand for apple pickers. We consider this linkage among the factors of production more fully later in the chapter.

Quick Quiz *Define* marginal product of labor *and* value of the marginal product of labor. • *Describe how a competitive, profit-maximizing firm decides how many workers to hire.*

18-2 The Supply of Labor

Having analyzed labor demand in detail, let's turn to the other side of the market and consider labor supply. A formal model of labor supply is included in Chapter 21, where we develop the theory of household decision making. Here we discuss briefly and informally the decisions that lie behind the labor-supply curve.

18-2a The Trade-off between Work and Leisure

One of the *Ten Principles of Economics* in Chapter 1 is that people face trade-offs. Probably no trade-off is more obvious or more important in a person's life than the trade-off between work and leisure. The more hours you spend working, the fewer hours you have to watch TV, enjoy dinner with friends, or pursue your favorite hobby. The trade-off between labor and leisure lies behind the labor-supply curve.

Another of the *Ten Principles of Economics* is that the cost of something is what you give up to get it. What do you give up to get an hour of leisure? You give up an hour of work, which in turn means an hour of wages. Thus, if your wage is $15 per hour, the opportunity cost of an hour of leisure is $15. And when you get a raise to $20 per hour, the opportunity cost of enjoying leisure goes up.

The labor-supply curve reflects how workers' decisions about the labor-leisure trade-off respond to a change in that opportunity cost. An upward-sloping labor-supply curve means that an increase in the wage induces workers to increase the quantity of labor they supply. Because time is limited, more work means less leisure. That is, workers respond to the increase in the opportunity cost of leisure by taking less of it.

It is worth noting that the labor-supply curve need not be upward sloping. Imagine you got that raise from $15 to $20 per hour. The opportunity cost of leisure is now greater, but you are also richer than you were before. You might decide that with your extra wealth you can now afford to enjoy more leisure. That is, at the higher wage, you might choose to work fewer hours. If so, your labor-supply curve would slope backward. In Chapter 21, we discuss this possibility in terms of conflicting effects on your labor-supply decision (called the *income* and *substitution effects*). For now, we ignore the possibility of backward-sloping labor supply and assume that the labor-supply curve is upward sloping.

"I really didn't enjoy working five days a week, fifty weeks a year for forty years, but I needed the money."

18-2b What Causes the Labor-Supply Curve to Shift?

The labor-supply curve shifts whenever people change the amount they want to work at a given wage. Let's now consider some of the events that might cause such a shift.

Changes in Tastes In 1950, 34 percent of women were employed at paid jobs or looking for work. In 2012, the number had risen to 58 percent. There are many explanations for this development, but one of them is changing tastes, or attitudes toward work. Sixty years ago, it was the norm for women to stay at home and raise children. Today, the typical family size is smaller, and more mothers choose to work. The result is an increase in the supply of labor.

Changes in Alternative Opportunities The supply of labor in any one labor market depends on the opportunities available in other labor markets. If the wage earned by pear pickers suddenly rises, some apple pickers may choose to switch occupations, causing the supply of labor in the market for apple pickers to fall.

Immigration Movement of workers from region to region, or country to country, is another important source of shifts in labor supply. When immigrants come to the United States, for instance, the supply of labor in the United States increases, and the supply of labor in the immigrants' home countries falls. In fact, much of the policy debate about immigration centers on its effect on labor supply and, thereby, equilibrium wages in the labor market.

Quick Quiz *Who has a greater opportunity cost of enjoying leisure—a janitor or a brain surgeon? Explain. Can this help explain why doctors work such long hours?*

18-3 Equilibrium in the Labor Market

So far we have established two facts about how wages are determined in competitive labor markets:

- The wage adjusts to balance the supply and demand for labor.
- The wage equals the value of the marginal product of labor.

At first, it might seem surprising that the wage can do both of these things at once. In fact, there is no real puzzle here, but understanding why there is no puzzle is an important step toward understanding wage determination.

Figure 4 shows the labor market in equilibrium. The wage and the quantity of labor have adjusted to balance supply and demand. When the market is in this equilibrium, each firm has bought as much labor as it finds profitable at the equilibrium wage. That is, each firm has followed the rule for profit maximization: It has hired workers until the value of the marginal product equals the wage. Hence, the wage must equal the value of the marginal product of labor once it has brought supply and demand into equilibrium.

This brings us to an important lesson: *Any event that changes the supply or demand for labor must change the equilibrium wage and the value of the marginal product by the same amount because these must always be equal*. To see how this works, let's consider some events that shift these curves.

18-3a Shifts in Labor Supply

Suppose that immigration increases the number of workers willing to pick apples. As Figure 5 shows, the supply of labor shifts to the right from S_1 to S_2. At the initial wage W_1, the quantity of labor supplied now exceeds the quantity demanded. This surplus of labor puts downward pressure on the wage of apple pickers, and the fall in the wage from W_1 to W_2 in turn makes it profitable for firms to hire more workers. As the number of workers employed in each apple orchard rises, the marginal product of a worker falls, and so does the value of the marginal product. In the new equilibrium, both the wage and the value of the marginal product of labor are lower than they were before the influx of new workers.

FIGURE 4

Equilibrium in a Labor Market

Like all prices, the price of labor (the wage) depends on supply and demand. Because the demand curve reflects the value of the marginal product of labor, in equilibrium workers receive the value of their marginal contribution to the production of goods and services.

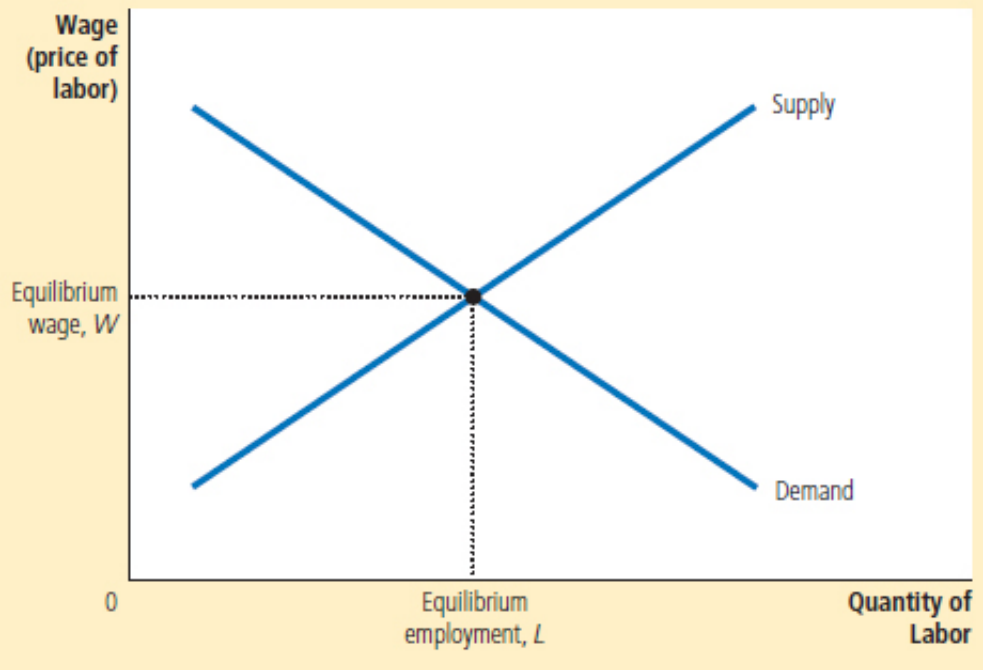
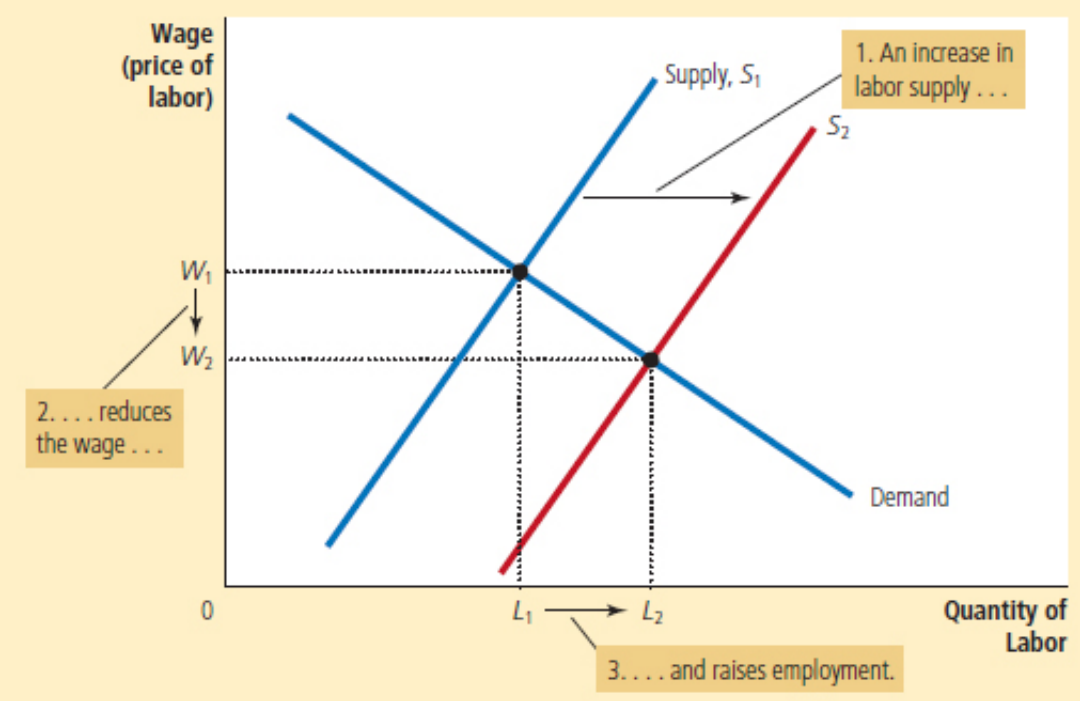


FIGURE 5

A Shift in Labor Supply

When labor supply increases from S_1 to S_2, perhaps because of an immigration of new workers, the equilibrium wage falls from W_1 to W_2. At this lower wage, firms hire more labor, so employment rises from L_1 to L_2. The change in the wage reflects a change in the value of the marginal product of labor: With more workers, the added output from an extra worker is smaller.



An episode from Israel, studied by MIT economist Joshua Angrist, illustrates how a shift in labor supply can alter the equilibrium in a labor market. During

most of the 1980s, many thousands of Palestinians regularly commuted from their homes in the Israeli-occupied West Bank and Gaza Strip to jobs in Israel, primarily in the construction and agriculture industries. In 1988, however, political unrest in these occupied areas induced the Israeli government to take steps that, as a by-product, reduced this supply of workers. Curfews were imposed, work permits were checked more thoroughly, and a ban on overnight stays of Palestinians in Israel was enforced more rigorously. The economic impact of these steps was exactly as theory predicts: The number of Palestinians with jobs in Israel fell by half, while those who continued to work in Israel enjoyed wage increases of about 50 percent. With a reduced number of Palestinian workers in Israel, the value of the marginal product of the remaining workers was much higher.

18-3b Shifts in Labor Demand

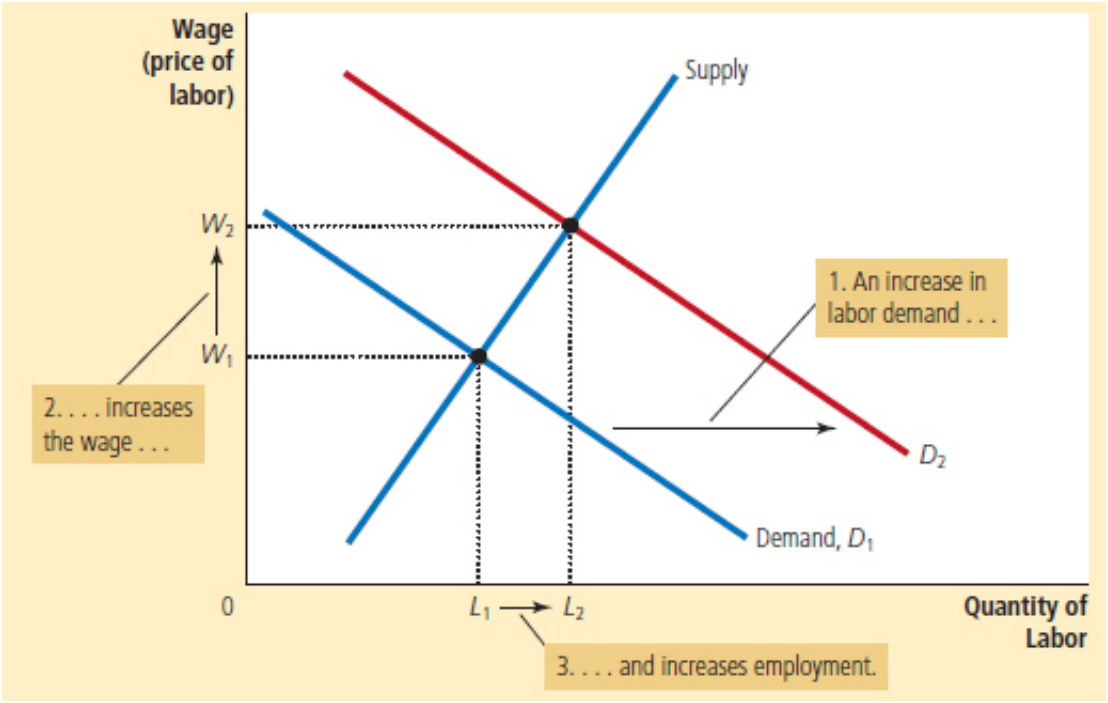
Now suppose that an increase in the popularity of apples causes their price to rise. This price increase does not change the marginal product of labor for any given number of workers, but it does raise the *value* of the marginal product. With a higher price for apples, hiring more apple pickers is now profitable. As Figure 6 shows, when the demand for labor shifts to the right from D_1 to D_2, the equilibrium wage rises from W_1 to W_2, and equilibrium employment rises from L_1 to L_2. Once again, the wage and the value of the marginal product of labor move together.

This analysis shows that prosperity for firms in an industry is often linked to prosperity for workers in that industry. When the price of apples rises, apple producers make greater profit, and apple pickers earn higher wages. When the price of apples falls, apple producers earn smaller profit, and apple pickers earn lower wages. This lesson is well known to workers in industries with highly volatile prices. Workers in oil fields, for instance, know from experience that their earnings are closely linked to the world price of crude oil.

FIGURE 6

A Shift in Labor Demand

When labor demand increases from D_1 to D_2, perhaps because of an increase in the price of the firm's output, the equilibrium wage rises from W_1 to W_2, and employment rises from L_1 to L_2. The change in the wage reflects a change in the value of the marginal product of labor: With a higher output price, the added output from an extra worker is more valuable.


Wage (price of labor)
Supply
W_2
W_1
1. An increase in labor demand . . .
2. . . . increases the wage . . .
D_2
Demand, D_1
0
L_1
L_2
Quantity of Labor
3. . . . and increases employment.

IN THE NEWS

The Economics of Immigration

Here is an interview with Pia Orrenius, a senior economist at the Federal Reserve Bank of Dallas who studies immigration.

Q: What can you tell us about the size of the immigrant population in the United States?

A: Immigrants make up about 13 percent of the overall population, which means about 40 million foreign-born live in the United States. The commonly accepted estimate for the undocumented portion of the foreign-born population is 11 million. Immigrants come from all parts of the world, but we've seen big changes in their origins. In the 1950s and 1960s, 75 percent of immigrants were from Europe. Today, about 80 percent are from Latin America and Asia. Inflows are also much larger today, with 1 million to 2 million newcomers entering each year. Still, 2010–2011 immigration was below the levels experienced prior to the Great Recession of 2007–2009, when the housing bust led to a significant decline in illegal immigration.

What's interesting about the United States is how our economy has been able to absorb immigrants and put them to work. U.S. immigrants are much more likely to be working compared with immigrants in other developed countries. This is partly because we don't set high entry-level wages or have cumbersome hiring and firing rules. In this type of flexible system, there are more job openings. Workers have more opportunities. Of course, entry-level wages are also lower, but immigrants at least get their foot in the door.

Pia Orrenius

Being in the workforce allows immigrants to interact with the rest of society. They learn the language faster, pay taxes and become stakeholders.

Q: Where do immigrants fit into the U.S. economy?

A: U.S. immigrants are diverse in economic terms. We rely on them to fill both high-and low-skilled jobs. Some immigrants do medium-skilled work, but more than anything else they're found on the low and the high ends of the education distribution.

The economic effects of immigration are different depending on which group you're talking about. We have an extremely important group of high-skilled immigrants. We rely on them to fill high-level jobs in health, science, technology, and engineering. Each year, over one-third of Ph.D.s in science and engineering is awarded to students who were

born abroad. Moreover, research shows that foreign-born workers in STEM fields [science, technology, engineering, and mathematics] are more innovative and entrepreneurial than their U.S.-born counterparts.

High-skilled immigration has many economic benefits—it boosts productivity growth and contributes positively to government finances. People tend to focus on undocumented or low-skilled immigrants when discussing immigration and often do not recognize the tremendous contributions of high-skilled immigrants.

Q: What about the low-skilled immigration?

A: With low-skilled immigration, the economic benefits of the added labor, such as lower prices for consumers, have to be balanced against the fiscal impact, which is likely negative. The fiscal impact is the difference between what families contribute in taxes and what they use up in the form of publicly provided services.

What makes the fiscal issue more difficult is the distribution of the burden. The federal government reaps much of the revenue from immigrants who work and pay employment taxes. State and local governments realize less of that benefit and have to pay more of the costs associated with low-skilled immigration—usually health care and educational expenses.

Q: Does it matter whether the immigration is legal or not?

A: Illegal immigration has helped fuel the U.S. economy for many years. Five percent of the U.S. workforce is made up of unauthorized workers; the outcome of decades of robust labor demand and, until recently, lax enforcement. Nevertheless, from an economic perspective, it makes more sense to differentiate among immigrants of various skill levels than it does to focus on legal status.

The economic benefits of low-skilled immigrants aren't typically going to depend on how they entered the United States. Illegal immigrants may pay less in taxes, but they're also ineligible for public programs. So being illegal doesn't mean these immigrants have a worse fiscal impact. In fact, a low-skilled illegal immigrant likely creates less fiscal burden than a low-skilled legal immigrant because the undocumented get almost no government benefits.

Q: How does immigration affect jobs and earnings for the native-born population?

A: Labor economists have looked long and hard at this question, namely how immigration has affected the wages of Americans, particularly the low-skilled who lack a high school degree. The reason we worry about this is that the real wages of less-educated U.S. men have been falling since the late 1970s.

The studies tend to show that little of the decline is due to immigration. The consensus seems to be that wages overall are about 1 to 3 percent lower today as a result of immigration, although some scholars find larger effects for low-skilled workers. Still, labor economists think it's a bit of a puzzle that they haven't been able to systematically identify larger adverse wage effects.

The reason may be the way the economy is constantly adjusting to the inflow of immigrants. On a geographical basis, for example, a large influx of immigrants into an area tends to encourage an inflow of capital or a change in technology or production processes which puts new workers to use. So you have an increase in labor supply, but you also have an increase in labor demand, and the

wage effects are ameliorated.

Source: This interview, updated for this edition by Dr. Orrenius, was originally published in *Southwest Economy*, March/April 2006.

From these examples, you should now have a good understanding of how wages are set in competitive labor markets. Labor supply and labor demand together determine the equilibrium wage, and shifts in the supply or demand curve for labor cause the equilibrium wage to change. At the same time, profit maximization by the firms that demand labor ensures that the equilibrium wage always equals the value of the marginal product of labor.

case study Productivity and Wages

One of the *Ten Principles of Economics* in Chapter 1 is that our standard of living depends on our ability to produce goods and services. We can now see how this principle works in the market for labor. In particular, our analysis of labor demand shows that wages equal productivity as measured by the value of the marginal product of labor. Put simply, highly productive workers are highly paid, and less productive workers are less highly paid.

This lesson is key to understanding why workers today are better off than workers in previous generations. Table 2 presents some data on growth in productivity and growth in real wages (that is, wages adjusted for inflation). From 1959 to 2012, productivity as measured by output per hour of work grew about 2.1 percent per year. Real wages grew at 1.8 percent—almost the same rate. With a growth rate of 2 percent per year, productivity and real wages double about every 35 years.

Productivity growth varies over time. Table 2 also shows the data for three shorter periods that economists have identified as having very different productivity experiences. Around 1973, the U.S. economy experienced a significant slowdown in productivity growth that lasted until 1995. The cause of the productivity slowdown is not well understood, but the link between productivity and real wages is exactly as standard theory predicts. The slowdown in productivity growth from 2.8 to 1.4 percent per year coincided with a slowdown in real wage growth from 2.8 to 1.1 percent per year.

Productivity growth picked up again around 1995, and many observers hailed the arrival of the "new economy." This productivity acceleration is most often attributed to the spread of computers and information technology. As theory predicts, growth in real wages picked up as well. From 1995 to 2012, productivity grew by 2.3 percent per year, and real wages grew by 1.9 percent per year.

The bottom line: Both theory and history confirm the close connection between productivity and real wages.

TABLE 2

Productivity and Wage Growth in the United States

Time Period	Growth Rate of Productivity	Growth Rate of Real Wages
1959–2012	2.1%	1.8%
1959–1973	2.8	2.8

1973–1995	1.4	1.1
1995–2012	2.3	1.9

Source: Bureau of Labor Statistics. Growth in productivity is measured here as the annualized rate of change in output per hour in the nontarm business sector. Growth in real wages is measured as the annualized change in compensation per hour in the nontarm business sector divided by the implicit price deflator tor that sector. These productivity data measure average productivity—the quantity of output divided by the quantity of labor—rather than marginal productivity, but average and marginal productivity are thought to move closely together.

Quick Quiz *How does an immigration of workers affect labor supply, labor demand, the marginal product of labor, and the equilibrium wage?*

FYI Monopsony

On the preceding pages, we built our analysis of the labor market with the tools of supply and demand. In doing so, we assumed that the labor market was competitive. That is, we assumed that there were many buyers and sellers of labor, so each buyer or seller had a negligible effect on the wage.

Yet imagine the labor market in a small town dominated by a single, large employer. That employer can exert a large influence on the going wage, and it may well use that market power to alter the outcome. Such a market in which there is a single buyer is called a *monopsony*.

A monopsony (a market with one buyer) is in many ways similar to a monopoly (a market with one seller). Recall from Chapter 15 that a monopoly firm produces less of the good than would a competitive firm; by reducing the quantity offered for sale, the monopoly firm moves along the product's demand curve, raising the price and also its profits.

Similarly, a monopsony firm in a labor market hires fewer workers than would a competitive firm; by reducing the number of jobs available, the monopsony firm moves along the labor supply curve, reducing the wage it pays and raising its profits. Thus, both monopolists and monopsonists reduce economic activity in a market below the socially optimal level. In both cases, the existence of market power distorts the outcome and causes deadweight losses.

This book does not present the formal model of monopsony because monopsonies are rare. In most labor markets, workers have many possible employers, and firms compete with one another to attract workers. In this case, the model of supply and demand is the best one to use.

18-4 The Other Factors of Production: Land and Capital

We have seen how firms decide how much labor to hire and how these decisions determine workers'

wages. At the same time that firms are hiring workers, they are also deciding about other inputs to production. For example, our

apple-producing firm might have to choose the size of its apple orchard and the number of ladders for its apple pickers. We can think of the firm's factors of production as falling into three categories: labor, land, and capital.

The meaning of the terms *labor* and *land* is clear, but the definition of *capital* is somewhat tricky. Economists use the term **capital** to refer to the stock of equipment and structures used for production. That is, the economy's capital represents the accumulation of goods produced in the past that are being used in the present to produce new goods and services. For our apple firm, the capital stock includes the ladders used to climb the trees, the trucks used to transport the apples, the buildings used to store the apples, and even the trees themselves.

capital
the equipment and structures used to produce goods and services

18-4a Equilibrium in the Markets for Land and Capital

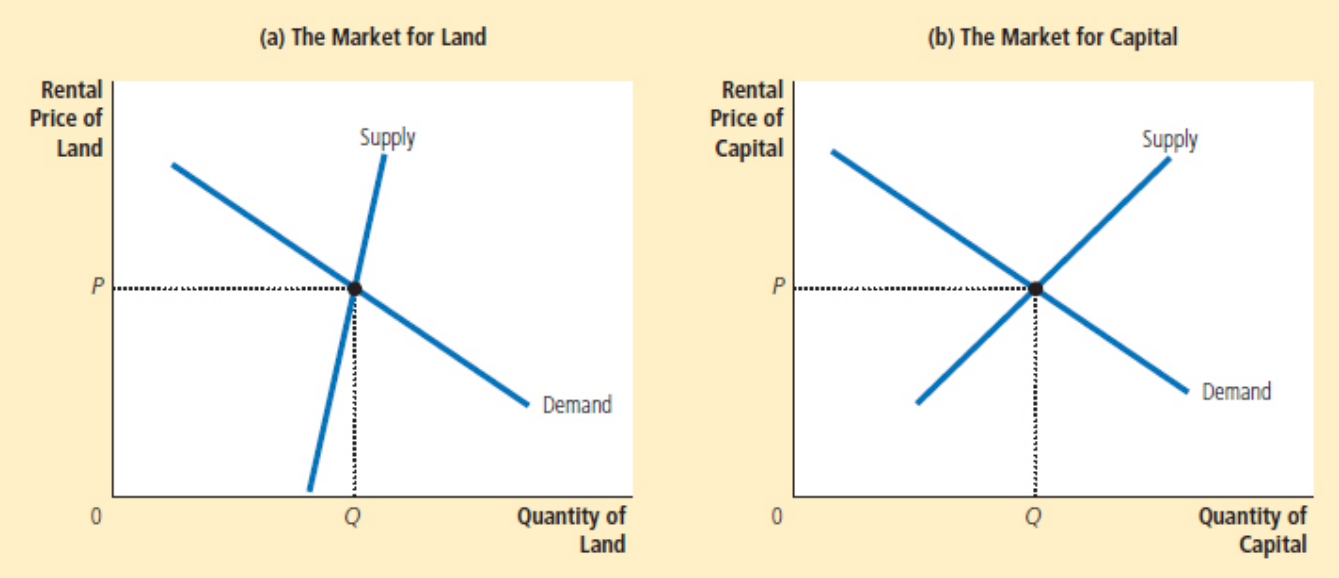
What determines how much the owners of land and capital earn for their contribution to the production process? Before answering this question, we need to distinguish between two prices: the purchase price and the rental price. The *purchase price* of land or capital is the price a person pays to own that factor of production indefinitely. The *rental price* is the price a person pays to use that factor for a limited period of time. It is important to keep this distinction in mind because, as we will see, these prices are determined by somewhat different economic forces.

Having defined these terms, we can now apply the theory of factor demand that we developed for the labor market to the markets for land and capital. Because the wage is the rental price of labor, much of what we have learned about wage determination applies also to the rental prices of land and capital. As Figure 7 illustrates, the rental price of land, shown in panel (a), and the rental price of capital, shown in panel (b), are determined by supply and demand. Moreover, the demand for land and capital is determined just like the demand for labor. That is, when our apple-producing firm is deciding how much land and how many ladders to rent, it follows the same logic as when deciding how many workers to hire. For both land and capital, the firm increases the quantity hired until the value of the factor's marginal product equals the factor's price. Thus, the demand curve for each factor reflects the marginal productivity of that factor.

FIGURE 7

The Markets for Land and Capital

Supply and demand determine the compensation paid to the owners of land, as shown in panel (a), and the compensation paid to the owners of capital, as shown in panel (b). The demand for each factor, in turn, depends on the value of the marginal product of that factor.


(a) The Market for Land
Rental Price of Land
Supply
P
Demand
0
Q
Quantity of Land
(b) The Market for Capital
Rental Price of Capital
Supply
P
Demand
0
Q
Quantity of Capital

FYI What Is Capital Income?

Labor income is an easy concept to understand: It is the paycheck that workers get from their employers. The income earned by capital, however, is less obvious.

In our analysis, we have been implicitly assuming that households own the economy's stock of capital—ladders, drill presses, warehouses, and so on—and rent it to the firms that use it. Capital income, in this case, is the rent that households receive for the use of their capital. This assumption simplified our analysis of how capital owners are compensated, but it is not entirely realistic. In fact, firms usually own the capital they use, and therefore, they receive the earnings from this capital.

These earnings from capital, however, are paid to households eventually in a variety of forms. Some of the earnings are paid in the form of interest to those households that have lent money to firms. Bondholders and bank depositors are two examples of recipients of interest. Thus, when you receive interest on your bank account, that income is part of the economy's capital income.

In addition, some of the earnings from capital are paid to households in the form of dividends. Dividends are payments by a firm to the firm's stockholders. A stockholder is a person who has bought a share in the ownership of the firm and, therefore, is entitled to share in the firm's profits.

A firm does not have to pay out all its earnings to households in the form of interest and dividends. Instead, it can retain some earnings within the firm and use these earnings to buy additional capital. Unlike dividends, these retained earnings do not yield a direct cash payment to the firm's stockholders, but the stockholders benefit from them nonetheless. Because retained earnings increase the amount of capital the firm owns, they tend to increase future earnings and, thereby, the value of the firm's stock.

These institutional details are interesting and important, but they do not alter our conclusion about the income earned by the owners of capital. Capital is paid according to the value of its marginal product, regardless of whether this income is transmitted to households in the form of interest or dividends or whether it is kept within firms as retained earnings.

We can now explain how much income goes to labor, how much goes to landowners, and how much goes to the owners of capital. As long as the firms using the factors of production are competitive and profit-maximizing, each factor's rental price must equal the value of the marginal product for that

factor. *Labor, land, and capital each earn the value of their marginal contribution to the production process*.

Now consider the purchase price of land and capital. The rental price and the purchase price are related: Buyers are willing to pay more for a piece of land or capital if it produces a valuable stream of rental income. And as we have just seen, the equilibrium rental income at any point in time equals the value of that factor's marginal product. Therefore, the equilibrium purchase price of a piece of land or capital depends on both the current value of the marginal product and the value of the marginal product expected to prevail in the future.

18-4b Linkages among the Factors of Production

We have seen that the price paid for any factor of production—labor, land, or capital—equals the value of the marginal product of that factor. The marginal product of any factor, in turn, depends on the quantity of that factor that is available. Because of diminishing marginal product, a factor in abundant supply has a low marginal product and thus a low price, and a factor in scarce supply has a

high marginal product and a high price. As a result, when the supply of a factor falls, its equilibrium price rises.

When the supply of any factor changes, however, the effects are not limited to the market for that factor. In most situations, factors of production are used together in a way that makes the productivity of each factor depend on the quantities of the other factors available for use in the production process. As a result, when some event changes the supply of any one factor of production, it will typically affect not only the earnings of that factor but also the earnings of all the factors as well.

For example, suppose a hurricane destroys many of the ladders that workers use to pick apples from the orchards. What happens to the earnings of the various factors of production? Most obviously, when the supply of ladders falls, the equilibrium rental price of ladders rises. Those owners who were lucky enough to avoid damage to their ladders now earn a higher return when they rent out their ladders to the firms that produce apples.

Yet the effects of this event do not stop at the ladder market. Because there are fewer ladders with which to work, the workers who pick apples have a smaller marginal product. Thus, the reduction in the supply of ladders reduces the demand for the labor of apple pickers, and this shift in demand causes the equilibrium wage to fall.

This story shows a general lesson: *An event that changes the supply of any factor of production can alter the earnings of all the factors*. The change in earnings of any factor can be found by analyzing the impact of the event on the value of the marginal product of that factor.

case study The Economics of the Black Death

In 14th-century Europe, the bubonic plague wiped out about one-third of the population within a few years. This event, called the *Black Death*, provides a grisly natural experiment to test the theory of factor markets that we have just developed. Consider the effects of the Black Death on those who were lucky enough to survive. What do you think happened to the wages earned by workers and the rents earned by landowners?

To answer this question, let's examine the effects of a reduced population on the marginal product of labor and the marginal product of land. With a smaller supply of workers, the marginal product of labor rises. (This is diminishing marginal product working in reverse.) Thus, we would expect the Black Death to raise wages.

Because land and labor are used together in production, a smaller supply of workers also affects the market for land, the other major factor of production in medieval Europe. With fewer workers available to farm the land, an additional unit of land produced less additional output. In other words, the marginal product of land fell. Thus, we would expect the Black Death to lower rents.

Workers who survived the plague were lucky in more ways than one.

In fact, both predictions are consistent with the historical evidence. Wages approximately doubled during this period, and rents declined 50 percent or more. The Black Death led to economic prosperity for the peasant classes and reduced incomes for the landed classes.

Quick Quiz *What determines the income of the owners of land and capital? • How would an increase in the quantity of capital affect the incomes of those who already own capital? How would it affect the incomes of workers?*

18-5 Conclusion

This chapter explained how labor, land, and capital are compensated for the roles they play in the production process. The theory developed here is called the *neoclassical theory of distribution*. According to the neoclassical theory, the amount paid to each factor of production depends on the supply and demand for that factor. The demand, in turn, depends on that particular factor's marginal productivity. In equilibrium, each factor of production earns the value of its marginal contribution to the production of goods and services.

The neoclassical theory of distribution is widely accepted. Most economists begin with the neoclassical theory when trying to explain how the U.S. economy's $15 trillion of income is distributed among the economy's various members. In the following two chapters, we consider the distribution of income in more detail. As you will see, the neoclassical theory provides the framework for this discussion.

Even at this point, you can use the theory to answer the question that began this chapter: Why are computer programmers paid more than gas station attendants? It is because programmers can produce a good of greater market value than can gas station attendants. People are willing to pay dearly for a good computer game, but they are willing to pay little to have their gas pumped and their windshield washed. The wages of these workers reflect the market prices of the goods they produce. If people suddenly got tired of using computers and decided to spend more time driving, the prices of these goods would change, and so would the equilibrium wages of these two groups of workers.

Summary

- The economy's income is distributed in the markets for the factors of production. The three most important factors of production are labor, land, and capital.
- The demand for factors, such as labor, is a derived demand that comes from firms that use the factors to produce goods and services. Competitive, profit-maximizing firms hire each factor up to the point at which the value of the factor's marginal product equals its price.
- The supply of labor arises from individuals' trade-off between work and leisure. An upward-sloping labor-supply curve means that people respond to an increase in the wage by working more hours and enjoying less leisure.
- The price paid to each factor adjusts to balance the supply and demand for that factor. Because factor demand reflects the value of the marginal product of that factor, in equilibrium each factor is compensated according to its marginal contribution to the production of goods and services.
- Because factors of production are used together, the marginal product of any one factor depends on the quantities of all factors that are available. As a result, a change in the supply of one factor alters the equilibrium earnings of all the factors.

Key Concepts

factors of production, *p. 374*
production function, *p. 376*

marginal product of labor, *p. 376*
diminishing marginal product, *p. 376*
value of the marginal product, *p. 377*
capital, *p. 387*

Questions for Review

1.