CHAPTER 14

Markets for Factor Inputs

So far we have concentrated on *output markets, i.e.,* markets for goods and services that firms sell and consumers purchase. In this chapter we discuss *factor markets*-markets for labor, raw materials, and other inputs to production. Much of our material will be familiar because the same forces that shape supply and demand in output markets also affect factor markets.

We have seen that some output markets are perfectly or almost perfectly competitive, while in others producers have market power. The same is true for factor markets. We will examine three different factor market structures: (1) perfectly competitive factor markets, (2) markets in which buyers of factors have monopsony power, and (3) markets in which sellers of factors have monopoly power. We will also point out instances in which equilibrium in the factor market depends on how much market power there is in *output* markets.

14.1 *Competitive Factor Markets*

A competitive factor market is one in which there are a large number of sellers and buyers of the factor of production. Because no single seller or buyer can affect the price of the factor, each is a price taker. For example, if individual firms that buy lumber to construct homes purchase a small share of the total volume of lumber available, their purchasing decision will have no effect on price. Similarly, if suppliers of lumber each control a small share of the market, their supply decisions will not affect the price of the lumber they sell.

We begin by analyzing the demands for a factor by individual firms. These demands are added to get market demand. We then shift to the supply side of the market and show how market price and input levels are determined.

Demand for a Factor Input When Only One Input Is Variable

Demand curves for factors of production are downward sloping, just like demand curves for the final goods that result from the production process. Unlike consumers' demands for goods and services, however, factor demands are *derived demands*-they depend on, and are derived from, the firm's level of output and the costs of inputs. For example, the demand of Microsoft Corporation for computer programmers is a derived demand that depends not only on the current salaries of programmers, but also on how much software Microsoft expects to sell.

To analyze factor demands, we will use the material from Chapter 7 that shows how a firm chooses its production inputs. We will assume that the firm produces its output using two inputs, capital *K* and labor *L*, that can be purchased at the prices *r* (the rental cost of capital) and *w* (the wage rate), respectively.[1] We will also assume that the firm has its plant and equipment in place (as in a short-run analysis), and must decide how much labor to hire.

Suppose that the firm has hired a certain number of workers and wants to know whether it is profitable to hire one additional worker. This will be profitable if the additional revenue from the output of the worker's labor is greater than the cost of his or her labor. The additional revenue from an incremental unit of labor, the *marginal revenue product of labor,* is denoted MRP_L. We know that the firm should hire more labor if the MRP_L is at least as large as the wage rate w.

How do we measure the MRP_L? It's the additional output obtained from the additional unit of labor, multiplied by the additional revenue from an extra unit of output. The additional output is given by the marginal product of labor MP_L and the additional revenue by the marginal revenue MR. Thus[2]

$$MRP_L = (MP_L)(MR) \tag{14.1}$$

This important result holds for any competitive factor market, whether the output market is competitive or not. However, to examine the characteristics of the MRP_L, let's begin with the case of a perfectly competitive output (and input) market. In a competitive output market, a firm will sell all its output at the market price *P*. The marginal revenue from the sale of an additional unit of output is then equal to *P*. In this case the marginal revenue product of labor is equal to the marginal product of labor times the price of the product:

$$MRP_L = (MP_L)(P) \tag{14.2}$$

The higher of the two curves in Figure 14.1 represents the MRP_L curve for a firm in a competitive output market. Note that the marginal product of la-

[1] We implicitly assume that all inputs to production are identical in quality. Differences in workers' skills and abilities are discussed in Chapter 17.

[2] The marginal revenue product is $\Delta R/\Delta L$, where L is the number of units of labor input and *R is* revenue. Note that $MP_L = \Delta Q/\Delta L$, and $MR = \Delta R/\Delta Q$, where *Q* is output. Therefore, $MRP_L = \Delta R/\Delta L = (\Delta R/\Delta Q)(\Delta Q/\Delta L) = (MR)(MP_L)$.

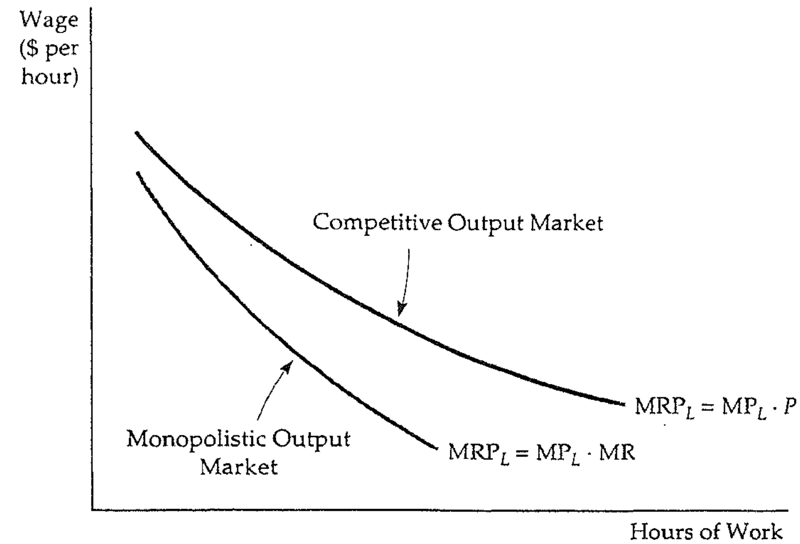

FIGURE 14.1 Marginal Revenue Product. In a Competitive factor market in which the producer of the product is a price taker, the buyer's demand for an input is given by the marginal revenue product curve. The.MRP curve falls because the marginal product of labor falls as hours of work increases. When the producer of the product has monopoly power, the demand for the input is also given by the MRP curve, but the MRP curve falls because both the marginal product of labor and marginal revenue fall.

bor falls as the number of hours of labor increases because there are diminishing returns to labor. The marginal revenue product curve thus slopes downward, even though the price of the product is constant.

The lower curve in Figure 14.1 is the MRP_L curve when the firm has monopoly power in the output market. When firms have monopoly power, they must lower the price of all units, of the product to sell more of it. As a result, marginal revenue is always less than price ($MR < P$), and marginal revenue falls as output increases. Thus, the marginal revenue product curve slopes downward in this case because the marginal revenue curve and the marginal product curve slope downward.

The concept of marginal revenue product can be applied to firms' hiring of workers; the marginal revenue product tells us how much the firm will pay to hire an additional unit of labor. As long as the MRP_L is greater than the wage rate, the firm should hire an additional unit of labor. If the marginal revenue product is less than the wage rate, the firm should lay off workers. Only when the marginal revenue product is equal to the wage rate will the firm have hired the profit-maximizing amount of labor. So the profit-maximizing condition is

$$\boxed{MRP_L = w} \tag{14.3}$$

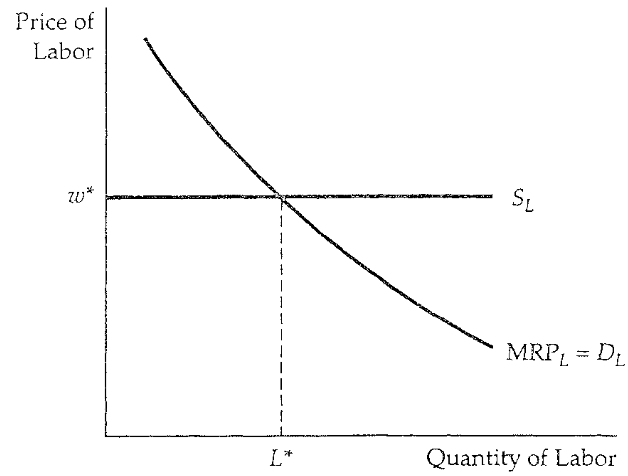

FIGURE 14.2 Hiring by a Firm in the Labor Market (with Capital Fixed). In a competitive labor market, a firm faces a perfectly elastic supply of labor S_L and can hire as many workers as it wants at a wage rate w^*. The firm's demand for labor D_L *is* given by its marginal revenue product of labor MRP_L. The profit-maximizing firm will hire L^* units of labor at the point where the marginal revenue product of labor is equal to the wage rate.

Figure 14.2 illustrates this condition. The demand for labor curve D_L is the MRP_L.Note that the quantity of labor demanded increases as the wage rate falls. Since the labor market is perfectly competitive, the firm can hire as many workers as it wants at the market wage w^*, so that the supply of labor curve facing the firm, S_L, is a horizontal line. The profit-maximizing amount of labor that the firm hires, L^*, is at the intersection of the supply and demand curves.

Figure 14.3 shows how the quantity of labor demanded changes in response to a drop in the market wage rate from w_1 to w_2. The wage rate might decrease if more people entering the labor force are looking for jobs for the first time (as happened, for example, when all the baby boomers came of age). The quantity of labor demanded by the firm is initially L_1, at the intersection of MRP_L and S_1. However, when the supply of labor curve shifts from S_1 to S_2 the wage falls from w_1 to w_2 and the quantity of labor demanded increases from L_1 to L_2.

Factor markets are similar to output markets in many ways. For example, the factor market profit-maximizing condition that the marginal revenue product of labor be equal to the wage rate is analogous to the output market condition that marginal revenue be equal to marginal cost. To see why this is true, recall that $MRP_L = (MP_L)(MR)$ and divide both sides of equation (14.3) by the marginal product of labor. Then,

$$MR = w/MP_L \tag{14.4}$$

Since MT_L measures the additional output per unit of input, the right-hand side of equation (14.4) measures the cost of an additional unit of output (the wage rate multiplied by the labor needed to produce one unit of output), i.e.,

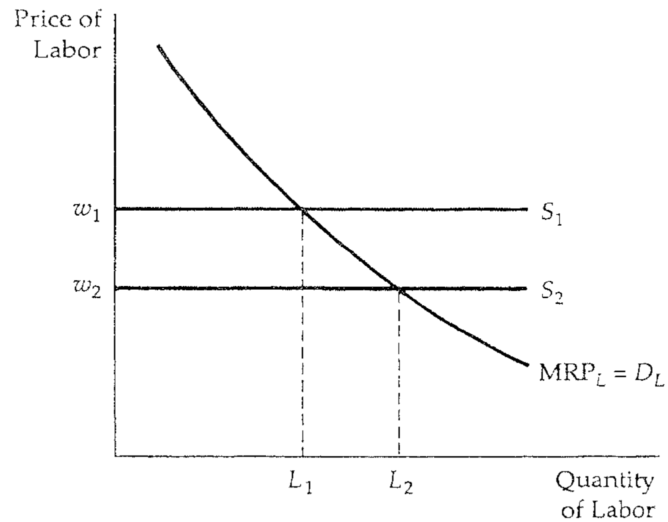

FIGURE 14.3 A Shift in the Supply of Labor. When the supply of labor facing the firm is S_1, the farm hires L_1 units of labor at wage w_1. But when the market wage rate decreases and the supply of labor shifts to S_2, the firm maximizes its profit by moving along the demand for labor curve until the new wage rate w_2 *is* equal to the marginal revenue product of labor, and L_2 units of labor are hired.

the marginal cost of production. Equation (14.4) shows that *both the hiring and output choices of the firm follow the same rule-inputs or outputs are chosen so that the marginal revenue (from the sale of output) is equal to marginal cost (from the purchase of inputs).* This result holds in both competitive and noncompetitive markets.

Demand for a Factor Input When Several Inputs Are Variable

When the firm simultaneously chooses quantities of two or more variable inputs, the hiring problem becomes more difficult because a change in the price of one input will change the demand for others. Suppose, for example, that both labor and assembly-line machinery are variable inputs to producing farm equipment, and we wish to determine the firm's demand for labor curve. As the wage rate falls, more labor v. ill be demanded even if the firm's investment in machinery is unchanged. But as labor becomes less expensive, the marginal cost of producing the farm equipment falls, which makes it profitable for the firm to increase its output. As a result, the firm is likely to invest in additional machinery to expand its production capacity. Expanding the use of machinery causes the marginal revenue product of labor curve to shift to the right, which in turn causes the quantity of labor demanded to increase.

Figure 14.4 illustrates this. Suppose that when the wage rate is $20 per hour, the firm hires 100 worker-hours, as shown by point *A* on the MRP_{L1} curve. Now consider what happens when the wage rate falls to $15 per hour. Be-

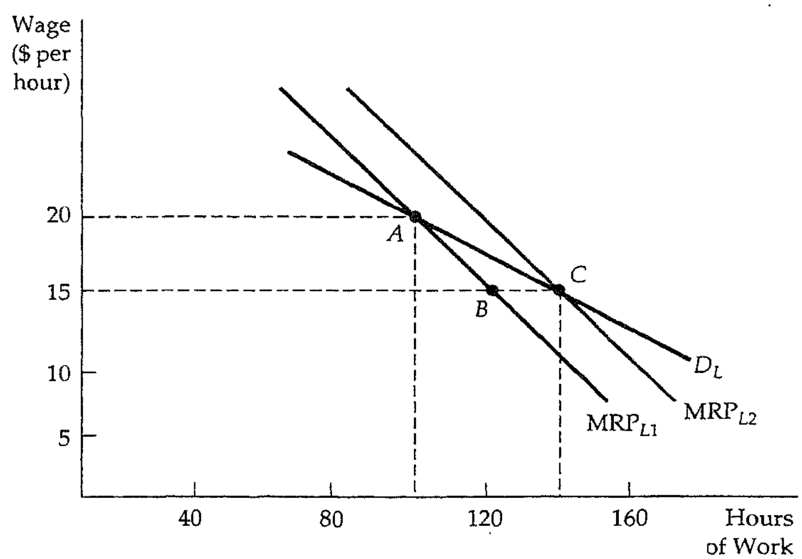

FIGURE 14.4 Firm's Demand Curve for Labor (with Variable Capital). When two or more inputs are variable, a firm's demand for one input depends on the marginal revenue product of both inputs. When the wage rate is $20, *A* represents one point on the firm's demand for labor curve. When the wage rate falls to $15, the MRP curve shifts from MRP_{L1} to MRP_{L2}, generating a new point *C* on the firm's demand for labor curve. Thus, *A* and *C* are on the demand for labor curve, but *B* is not

cause the marginal revenue product of labor is now greater than the wage rate, the firm will demand more labor. But the MRP_{L1} curve describes the demand for labor when the use of machinery is fixed. The lower wage will encourage the firm to hire more machinery as well as labor. Because there is more machinery, the marginal product of labor will increase (with more machinery, workers can be more productive), and the marginal revenue product curve will shift to the right (to MRP_{L2}). Thus, when the wage rate falls, the firm will use 140 hours of labor as shown by point *C*, rather than 120 hours as given by *B*. *A* and *C* are two points on the firm's demand for labor curve (with machinery variable) D_L. Note that as constructed, the demand for labor curve is more elastic than either of the two marginal product of labor curves (which presume no change in the amount of machinery). Thus, when capital inputs are variable in the long run there is a greater elasticity of demand because firms can substitute capital for labor in the production process.

The Market Demand Curve

When we aggregated the individual demand curves of consumers to obtain the market demand curve for a product, we were concerned with a single industry. However,-a factor input like skilled labor is demanded by firms in many different industries. To obtain the total market demand for labor curve, we must therefore first determine each industry's demand for labor, then add the industry demand curves horizontally. The second step is straightforward. Adding industry demand curves for labor to obtain a market demand curve for labor is just like adding individual product demand curves to obtain the market demand curve for that product. So let's concentrate our attention on the more difficult first step.

The first step-determining industry demand-takes into account that the level of output produced by the firm and its product price both change as the prices of the inputs to production change. It is easiest to determine market demand when there is a single producer of the product. Then, the marginal revenue product curve is the industry demand curve for the input. With many firms, however, the analysis is more complex because of the possible interaction among the firms. To illustrate, consider the demand for labor when output markets are perfectly competitive. Then, the marginal revenue product of labor is the product of the price of the good and of the marginal product of labor (see equation 14.2), as shown by the curve MRP_{L1} in Figure 14.5.

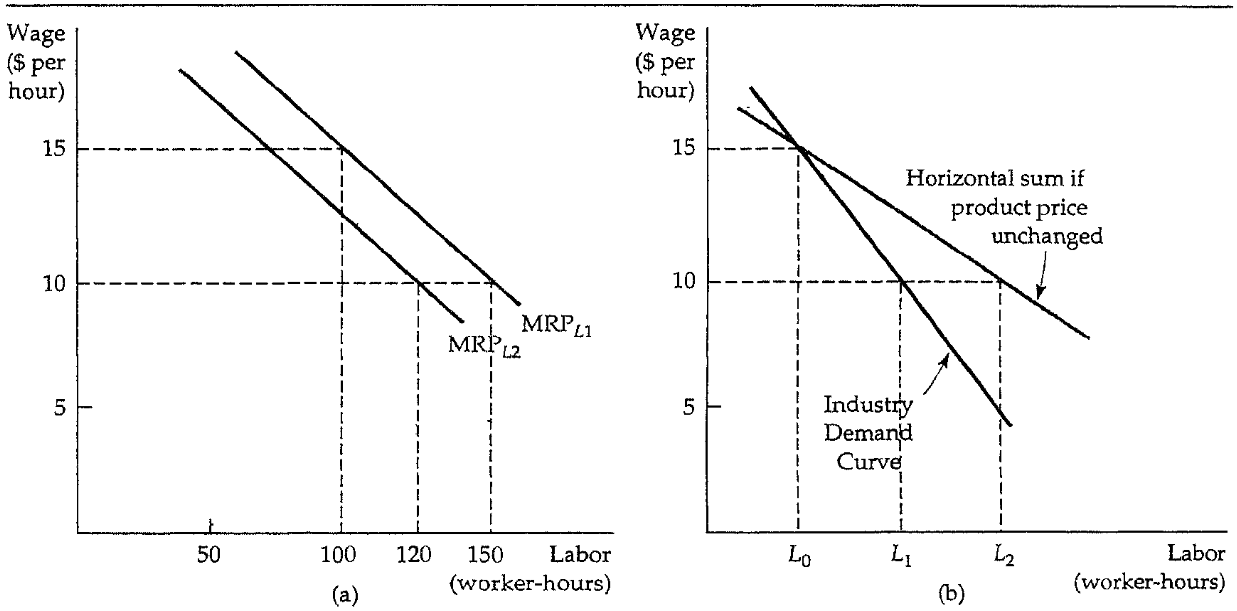

FIGURE 14.5 The Industry Demand for Labor. The demand curve for labor of a competitive firm, MRP_{L1} in (a), assumes that the product price is given. But as the wage rate falls from \$15 to \$10 per hour, the product price also falls, and the firm's demand curve shifts downward to MRP_{L2}. As a result, the industry demand curve, shown in (b), is more inelastic than the demand curve that would be obtained if the product price were assumed to be unchanged.

Suppose initially that the wage rate for labor is $15 per hour, and the firm demands 100 worker-hours of labor. Now the wage rate for this firm falls to $10 per hour. If no other firms could hire workers at the lower wage then our firm would hire 150 worker-hours of labor (by finding the point on the MRP_{L1} curve that corresponds to the $10-per-hour wage rate). But if the wage rate falls for all firms in an industry, the industry as a whole will hire more labor. This will lead to more output from the industry, a shift to the right of the industry supply curve, and a lower market price for the product.

In Figure 14.5a, when the product price falls, the original marginal revenue product curve shifts downward, from MRP_{L1} to MRP_{L2}. This leads to a smaller firm demand for labor than we originally expected-120 worker-hours rather than 150. Consequently, industry demand for labor will be lower than if only one firm were able to hire workers at the lower wage. Figure 14.5b illustrates this. The lighter line shows the horizontal sum of the individual firms' demands for labor that would result if the product price did not change as the wage falls. The darker line shows the industry demand curve for labor, which takes into account that the product price will fall as all firms expand their output in response to the lower wage rate. The industry demand for labor is L_0 worker-hours when the wage rate is $15 per hour. When the wage falls to $10 per hour, the industry demand increases to L_1, a smaller increase than L_2, which would occur if the product price were fixed. The aggregation of industry demand curves into the market demand curve for labor is the final step-to complete it *we* simply add the labor demanded in all industries.

The derivation of the market demand curve for labor (or any other input) is essentially the same when the output market is noncompetitive. The only difference is that it is more difficult to predict the change in product price in response to a change in the wage rate because each firm in the market is likely to be pricing strategically, rather than taking product price as given.

EXAMPLE 14.1 THE DEMAND FOR JET FUEL

Throughout the 1970s and the early 1980s fuel costs for U.S. airlines increased rapidly, in tandem with rising world oil prices. For example, whereas fuel costs made up 12.4 percent of total operating costs in 1971, fuel's share of operating costs rose to 24.6 percent in 1979. As we would expect, the amount of jet fuel used by airlines during this period fell as its price rose. Thus, the output of the airline industry, as measured by the number of ton-miles (one ton-mile is short for one ton of passengers, baggage, or freight transported one mile), rose by 29.6 percent, while the amount of jet fuel consumed increased by only 8.8 percent.

Understanding the demand for jet fuel is important to managers of oil refineries, who must decide how much jet fuel to produce, and to managers of airlines, who must project how their fuel purchases and costs will change when fuel prices rise.[3]

The effect of the increase in fuel costs on the airline industry depends on the ability of airlines either to cut fuel usage by reducing weight (by carrying less excess fuel) and flying slower (reducing drag and increasing engine efficiency) or to pass on their higher costs in prices to customers. Thus, the price elasticity of demand for jet fuel depends both on the ability to conserve fuel and on the elasticities of demand and supply of travel.

To measure the short-run elasticity of demand for jet fuel, we use as the quantity of fuel demanded the number of gallons of fuel used by an airline in all markets within its domestic route network. The price of jet fuel is measured in dollars per gallon. A statistical analysis of demand must control for factors other than price that can explain why some firms demand more fuel than others. One factor is that some airlines are using more fuel-efficient jet aircraft, while others are not. A second factor is the length of the flights. The shorter the flight, the more fuel consumed per mile of travel. Both these factors were included in a statistical analysis that relates the quantity of fuel demanded to its price.[4] Table 14.1 shows some short-run price elasticities. (They do not account for the introduction of new types of aircraft.)

The jet fuel price elasticities for the airlines range in value from 0 (for Pan Am) to -15 (for Delta). Overall, the results show that the demand for jet fuel as an input to the production of airline flight-miles is very inelastic. This is not surprising-in the short run, there is no good substitute for jet fuel. The long-run elasticity of. demand is higher, however, because airlines can eventually introduce more energy-efficient airplanes.

Figure 14.6 shows the short- and long-run demands for jet fuel. The short-run demand curve, MRP$R, is much less elastic than the long-run demand

TABLE 144 Short-Run Price Elasticity of Demand for Jet Fuel

Airline	Elasticity	Airline	Elasticity
American	-.06	Braniff	-.10
Continental	-.09	Delta	-.15
Eastern	-.07	National	-.03
Northwest	-.07	Pan American	.00
TWA	-.10	United	-.10

[3] This example is drawn from Joseph M. Cigliano, "The Demand for Jet Fuel by the U.S. Domestic Trunk Airlines," *Business Economics* (Sept. 1982): 32-36.

[4] The study controls for the number of trips taken, so that the elasticities measured do not reflect the possibility that higher fuel prices may lead to fewer trips.

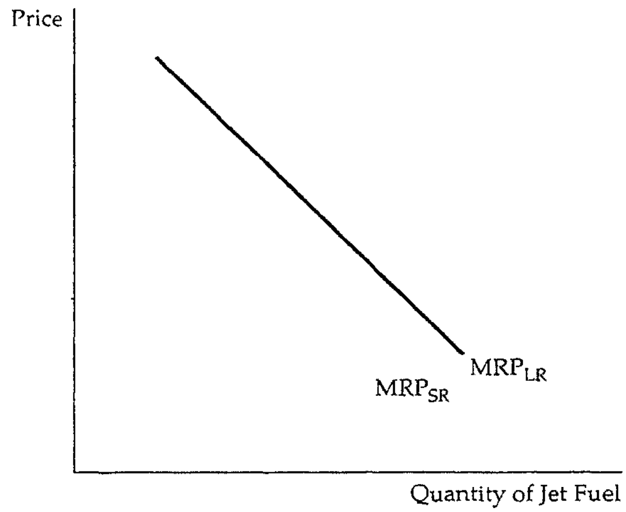

FIGURE 14.6 The Short- and Long-Run Demand for Jet Fuel. The short-run demand for jet fuel MRP_{SR} is more inelastic than the long-run demand MRP_{LR}. In the short run, airlines cannot reduce fuel consumption much when fuel prices increase. In the long run, however, the airlines can take longer, more fuel-efficient routes and put more fuel-efficient planes into service.

curve because it takes time to substitute newer, more fuel-efficient airplanes for other planes when the price of fuel goes up.

The Supply of Inputs to a Firm

When the market for a factor input is perfectly competitive, a firm can purchase as much of that input as it wants at a fixed price. The input supply curve facing a firm is then perfectly elastic,as in Figures 14.2 and 14.7b. In Figure 14.7b a firm is buying fabric at $10 per yard to sew into clothing. Because the firm is only a small part of the fabric market, it can buy all it wants without affecting the price.

The supply curve AE facing the firm in Figure 14.7b is an *average expenditure curve* (just as the demand curve facing a firm is an average revenue curve) because it represents the expenditure that the firm must make per unit of input that it purchases. The *marginal expenditure curve* ME, on the other hand, represents the expenditure of the firm for each *additional* unit of input it buys. (The marginal expenditure curve in a factor market is analogous to the marginal revenue curve in the output market.) When the factor market is competitive, the average expenditure and marginal expenditure curves are identical horizontal curves, just as the marginal and average revenue curves are identical (and horizontal) for a competitive firm in the output market.

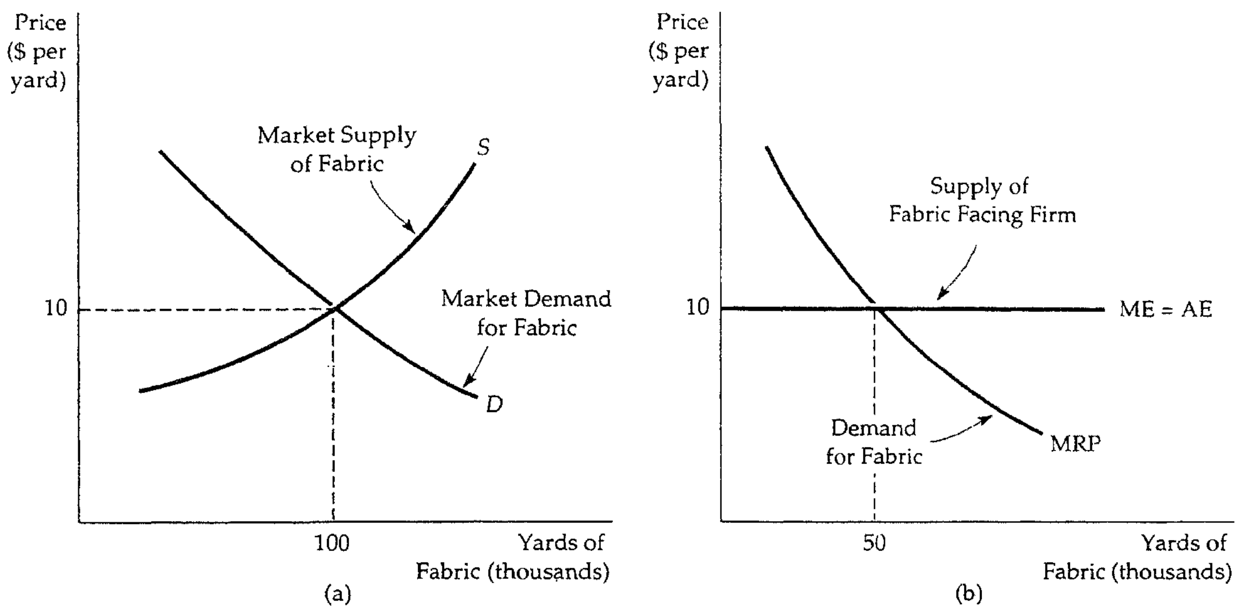

FIGURE 14.7 A Firm's Input Supply in a Competitive Factor Market. In a competitive factor market, a firm can buy any amount of the input it wants without affecting the price. Therefore, the firm faces a perfectly elastic supply curve for that input. As a result, the quantity of the input purchased by the producer of the product is determined by the intersection of the input demand and supply curves. In (a) the industry quantity demanded and quantity supplied of fabric are equated at a 'price of $10 per yard. In (b) the firm faces a horizontal marginal expenditure curve at a price of $10 per yard of fabric, and chooses to buy 50 yards.

How much of the input should a firm facing a competitive factor market purchase? As long as the marginal revenue product curve lies above the marginal expenditure curve, profit can be increased by purchasing more of the input because the benefit of an additional unit (MRP) exceeds the cost (ME). However, when the marginal revenue product curve lies below the marginal expenditure curve, some units yield benefits that are less than cost. Therefore, profit maximization requires that *marginal revenue product be equal to marginal expenditure:*

$$\boxed{\text{ME} = \text{MRP}} \tag{14.5}$$

When we considered the special case of a competitive output market, we saw that the firm bought inputs, such as labor, up to the point at which the marginal revenue product is equal to the price of the input w, as in equation (14.3). Thus, in the competitive case, the condition for profit maximization is that the price of the input be equal to marginal expenditure:

$$\boxed{\text{ME} = w} \tag{14.6}$$

In our example, the price of the fabric ($10 per yard) is determined in the competitive fabric market shown in Figure 14.7a, at the intersection of the demand and supply curves. Figure 14.7b shows the amount of fabric purchased by a firm at the intersection of the marginal expenditure and marginal revenue product curves. When 50 yards of fabric are purchased, the marginal expenditure of $10 is equal to the marginal revenue obtained from the sale of the clothing made possible by the increased use of fabric in the production process. If less than 50 yards of fabric were purchased, the firm would be forgoing an opportunity to make additional profit from clothing sales. If more than 50 yards were purchased, the cost of the fabric would be greater than the additional revenue that the firm would receive when it sold the extra clothing.

The Market Supply of Inputs

The market supply curve tor a factor is usually upward sloping. We saw in Chapter 8 that the market supply of a good sold in a competitive market is upward sloping when the marginal cost of production is increasing. The same argument applies to inputs such as fabric, which are usually produced with increasing marginal cost as well.

When the factor input is labor, however, people rather than firms are making supply decisions. Then, utility maximization rather than profit maximization becomes the operative goal. In the discussion that follows, we use the analysis of income and substitution effects from Chapter 4 to show that the market supply curve for labor can be upward sloping, but that it may also, as in Figure 14.8, be *backward bending,* i.e., a higher wage rate can lead to *less* labor being supplied.

To see why a labor supply curve may be backward bending, divide the day into hours of work and hours of leisure. Leisure is a generic term that describes nonwork activities, including sleeping and eating. Leisure is assumed to be enjoyable, but work benefits the worker only through the income that is earned. We also assume that a worker has the flexibility to choose how many hours per day to work.

The wage rate measures the price that the worker places on leisure time because the wage is the amount of money that the worker gives up to enjoy leisure. As the wage rate increases, the price of leisure also increases. This price change brings about both a substitution effect (a change in relative price with utility held constant) and an income effect (a change in utility with relative prices unchanged). There is a substitution effect because the higher price of leisure encourages workers to substitute work for leisure. An income effect occurs because the higher wage rate increases the worker's purchasing power. With this higher income, the worker can buy more of many goods, one of

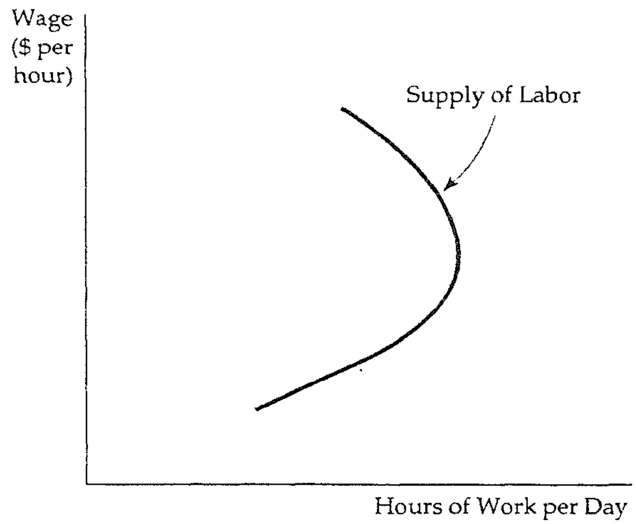

FIGURE 14.8 Backward-Bending Supply of Labor. When the wage rate increases, the hours of work supplied increase initially but eventually decrease as individuals choose to enjoy more leisure and to work less. The backward-bending portion of the labor supply curve arises when the income effect associated with the higher wage (which encourages more leisure) is greater than the substitution effect (which encourages more work).

which is leisure. If more leisure is purchased, then the income effect encourages the laborer to work fewer hours. Income effects can be very large because wages are the primary determinant of most people's income. When the income effect outweighs the substitution effect, the result is the backward-bending supply curve.

Figure 14.9 shows the work-leisure decision that leads to the backward-bending supply curve for labor. The horizontal axis shows hours of leisure per day, the vertical axis income generated by work. (We assume there are no other sources of income.) Initially the wage rate is $10 per hour, and the budget line is given by *PQ*. Point *P*, for example, shows that the individual who works a 24-hour day earns an income of $240.

The worker maximizes utility by choosing point A and by enjoying 16 hours of leisure per day (with 8 hours of work) and earning $80. When the wage rate increases to $20 per hour, the budget line rotates about the horizontal intercept to line *RQ*. (Only 24 hours of leisure are possible.) Now the worker maximizes utility at B by choosing 20 hours of leisure per day (with 4 hours of work), while earning $80 in the process. Were only the substitution effect to arise, the higher wage rate would encourage the worker to work 12 hours (at *C*) instead of 8. However, the income effect works in the opposite direction. It overcomes the substitution effect and lowers the work day from 8 to 4 hours.

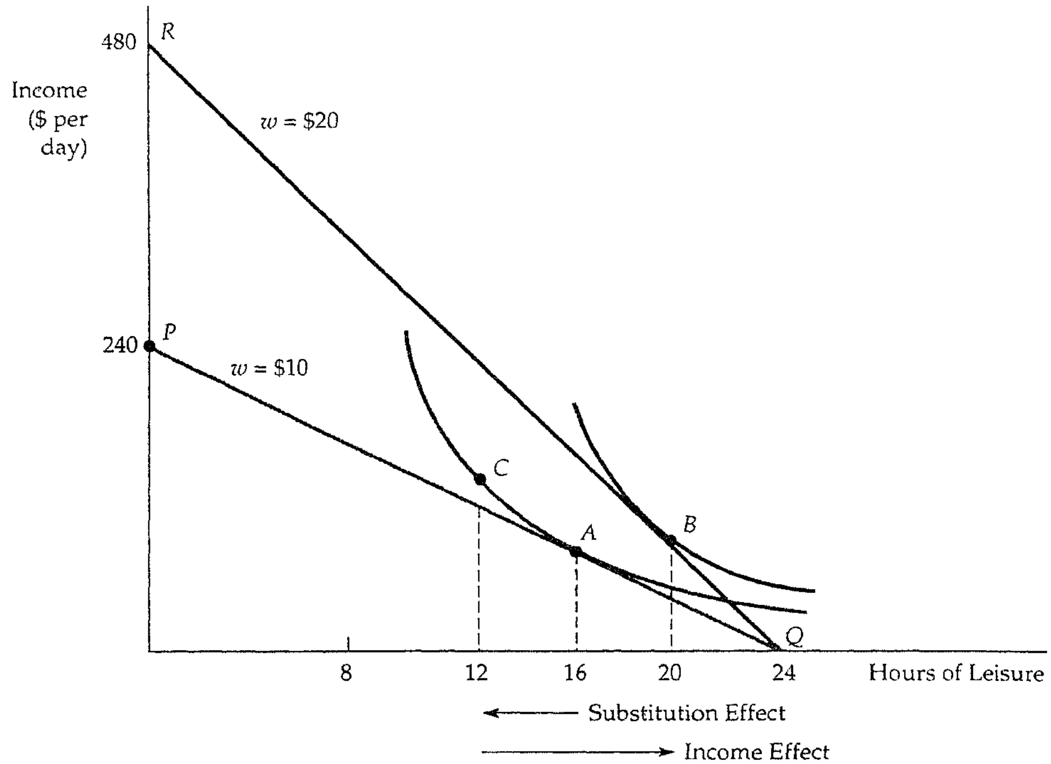

FIGURE 14.9 Substitution and Income Effects of a Wage Increase. When the wage rate increases from $10 to $20 per hour, the worker's budget line shifts from *PQ* to *RQ*. In response, the worker moves from *A* to *B*, while decreasing work hours from 8 to 4. The reduction in hours worked arises because the income effect outweighs the substitution effect. Then, the supply of labor curve is backward bending.

In real life, a backward-bending labor supply curve might apply to a college student working during the summer to earn living expenses for the school year. As soon as a target level of earnings is reached, the student stops working and allocates more time to leisure activities. An increase in the wage rate will then lead to fewer hours worked because it enables the student to reach the target level of earnings faster.

EXAMPLE 14.2 LABOR SUPPLY FOR ONE- AND TWO-EARNER HOUSEHOLDS

One of the most dramatic changes in the labor market in the twentieth century has been the increase in women's participation in the labor force. Women made up 29 percent of the labor force in 1950 and nearly 60 percent in 1993. Married women account for a substantial portion of this increase. The in-

TABLE 14.2 Elasticities of Labor Supply (Hours Worked)

Group	Head's Hours with Respect to Head's Wage	Spouse's Hours with Respect to Spouse's Wage	Head's Hours with Respect to Spouse's Wage
Unmarried males (no children)	.026		
Unmarried females (with children)	.106		
Unmarried females (no children)	.011		
One-earner family (with children)	-.078		
One-earner family (no children)	.007		
Two-earner family (with children)	-.002	-.086	-.004
Two-earner family (no children)	-.107	-.028	-.059

creased role of women in the labor market has also had a major impact on housing markets: Where to live and work has increasingly become a joint husband-and-wife decision. The complex nature of the work choice was analyzed in a study that compared the work decisions of 94 unmarried females with the work decisions of heads of households and spouses in 397 families.[5]

One way to describe the work decisions of the various family groups is to calculate labor supply elasticities. Each elasticity relates the numbers of hours worked to the wage that the head of household was paid, and also to the wage of the other member of two-earner households. Table 14.2 summarizes the, results.

When a higher wage rate leads to fewer hours worked, the labor supply curve is backward bending because the income effect, which encourages more leisure, outweighs the substitution effect, which encourages more work. The elasticity of labor supply is then negative. Table 14.2 shows that heads of one-earner families with children and two-earner families (with or without children) all have backward-bending labor supply curves, with elasticities ranging from -.002 to -.078. Most single-earner heads of households are on the upward-sloping portion of their labor supply curve, with the largest elasticity of .106 associated with single women with children. Married women (listed as spouses of heads of households) are also on the backward-bending portion of the labor supply curve, with elasticities of -.028 and -.086. This suggests that higher wages for women in two-earner families will discourage, rather than

[5] See Janet E. Kohlhase, "Labor Supply and Housing Demand for One- and Two-Earner Households," *Review of Economics and Statistics* 68 (1986): 48-56.

encourage, more work. The work decision of the head of the household is also responsive to the wage of the spouse: The household head works fewer hours when his or her spouse earns a higher wage.

14.2 *Equilibrium in a Competitive Factor Market*

A competitive factor market is in equilibrium when the price of the input equates the quantity demanded to the quantity supplied. Figure 14.10a shows such an equilibrium for a labor market. At point A, the equilibrium wage rate

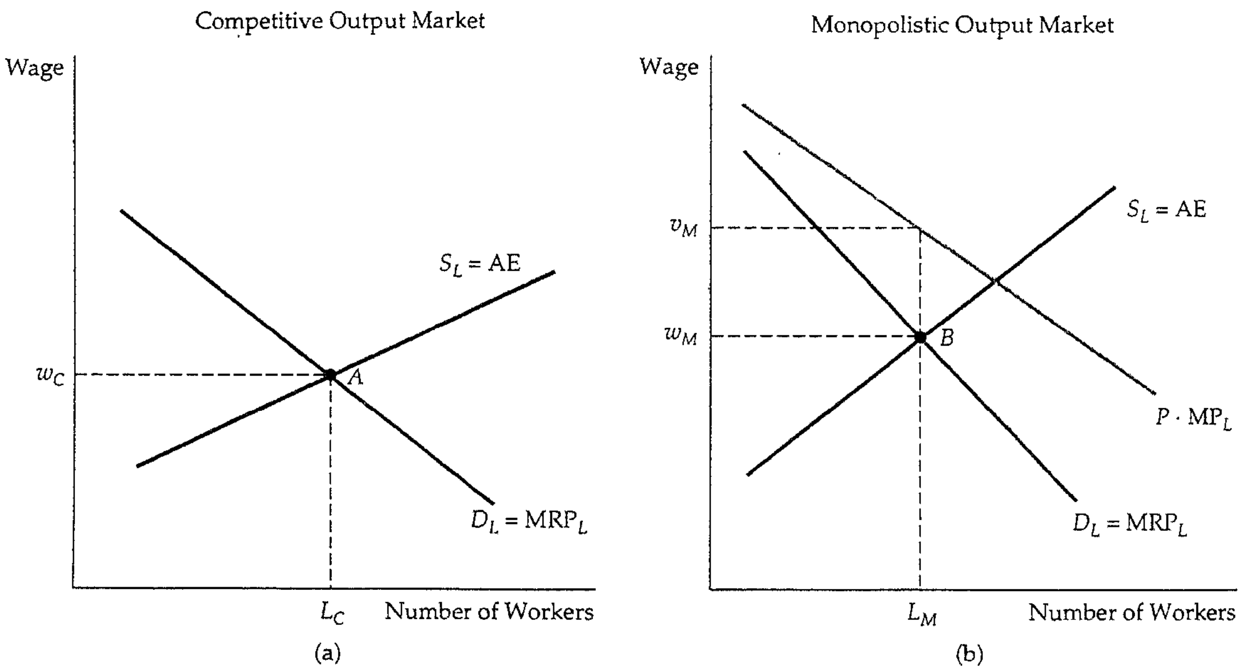

FIGURE 14.10 Labor Market Equilibrium. In a competitive labor market in which the output market is competitive, the equilibrium wage w_C is given by the intersection of the demand for labor (marginal revenue product) curve and the supply of labor (average expenditure) curve. This is point A in part (a) of the figure. Part (b) shows that when the producer of the product has monopoly power, the marginal value of a worker v_M is greater than the wage w_M, so that not enough workers are employed. (Point B determines the quantity of labor that the firm hires and the wage rate paid.)

is w_C, and the equilibrium quantity supplied is L_C. Since they are well informed, all workers receive the identical wage and generate the identical marginal revenue product of labor wherever they are employed. If any worker had a wage lower than his or her marginal product, a firm would find it profitable to offer that worker a higher wage.[6]

If the output market is also perfectly competitive, the demand curve for an input measures the benefit that consumers of the product place on the additional use of the input in the production process. The wage rate also reflects the cost to the firm and to society of using an additional unit of the input. Thus, at A in Figure 14.10a, the marginal benefit of an hour of labor (its marginal revenue product MRP_L) is equal to its marginal cost (the wage rate w).

When output and input markets are both perfectly competitive, resources are used efficiently because the difference between total benefits and total costs is maximized. Efficiency requires that the additional revenue received by the firm from employing an additional unit of labor (the marginal product of labor, MRP]J equal the social benefit of the additional output, given by the price of the product times the marginal product of labor, $(P)(MP_L)$.

When the output market is not perfectly competitive, the condition $MRP_L = (P)(MP_L)$ no longer holds. Note in Figure 14.10b that the curve representing the product price multiplied by the marginal product of labor $[(P)(MP_L)]$ lies above the marginal revenue product curve $[(MR)(MP_L)]$. Point B is the equilibrium wage w_M and the equilibrium labor supply L_M. But $(P)(MP_L)$ is the value that consumers place on additional inputs of labor. Therefore, when L_M laborers are employed, the marginal cost to the firm w_M is less than the marginal benefit to society v_M. The firm is maximizing its profit, but because its output is less than the efficient level,the firm uses less than the efficient level of the input.

Economic Rent

The concept of economic rent helps explain how factor markets work. When discussing output markets in Chapter 8, we defined economic rent as the payments received by a firm over and above the minimum cost of producing its output. For a factor market, *economic rent is the difference between the payments made to a factor of production and the minimum amount that must be spent to obtain the use of that factor.* Figure 14.11 illustrates the concept of economic rent as applied to a competitive labor market. The equilibrium price of labor is w^*, and the quantity of labor supplied is L^*. The supply of labor curve is the upward-sloping average expenditure curve, and the demand for labor is the downward-sloping marginal revenue product curve. Because the supply curve tells us how much labor will be supplied at each wage rate, the minimum expenditure

[6]As discussed in Chapter 17, however, when information is limited, employers can discriminate against workers.

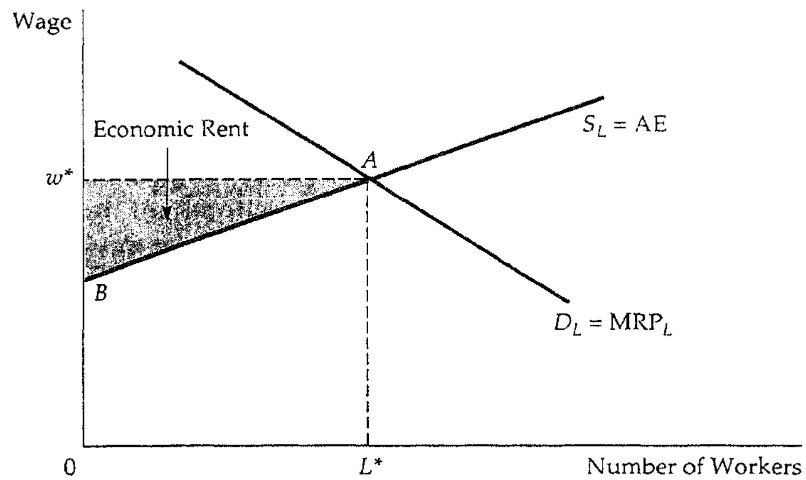

FIGURE 14.11 Economic Rent. The economic rent associated with the employment of labor is the excess of wages paid above the minimum amount needed to hire workers. The equilibrium wage is given by A, at the intersection of the labor supply and labor demand curves. Because the supply curve (AE) is upward sloping, some workers would have accepted jobs for a wage less than w^*. The red-shaded area ABw^* is the economic rent received by all workers.

needed to employ L^* units of labor is given by the tan-shaded region AL^*OB, the area below the supply curve to the left of the equilibrium labor supply L^*.

In perfectly competitive markets, all workers are paid the wage w^*. This wage is required to get the last "marginaF worker to supply his or her labor, but all other "mframarginal" workers earn rents because their wage is greater than the wage that would be needed to get them to work. Since total wage payments are equal to the rectangle $0w^*AL^*$, the economic rent earned by labor is given by the area Abw^*.

Note that if the supply curve were perfectly elastic, economic rent would be zero. Rents arise only when supply is somewhat inelastic. And when supply is perfectly inelastic, all payments to a factor of production are economic rents because the factor will be supplied no matter what price is paid.

One frequent example of an inelastically supplied factor is land, as Figure 14.12 shows. The supply curve is perfectly inelastic because land used to produce housing (or for agriculture) is fixed, at least in the short run. With land inelastically supplied, the price of land is determined entirely by demand. In the figure, the demand for land is given by D_1, and its price per unit is 5i. Totalland rent is given by the tan-shaded rectangle. But when the demand for land increases to D_2, the rental value per unit of land increases to $2, and the total land rent includes the red-shaded area as well. Thus, an increase in the demand for land (a shift to the right in the demand curve) leads to a higher price per acre, and a higher economic rent.

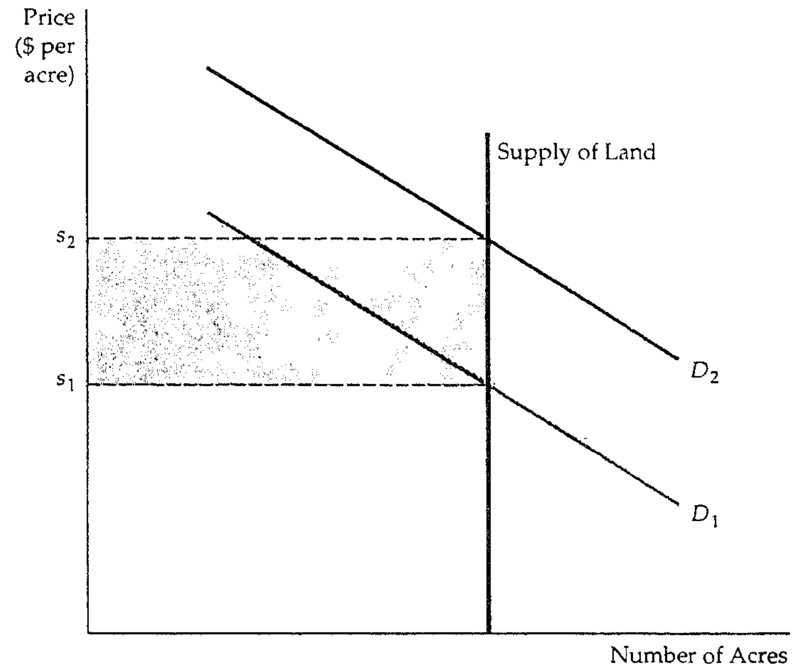

FIGURE 14.12 Land Rent. When the supply of land is perfectly inelastic, the market price of land is determined at the point of intersection with the demand curve, and the entire value of the land is an economic rent. When demand is given by D_1, the economic rent per acre is given by S_1, and when demand is increased to D_2, the economic rent increases to s_2.

EXAMPLE 14.3 PAY IN THE MILITARY

The U.S. Army has had a personnel problem for many years. During the Civil War, roughly 90 percent of the armed forces were unskilled workers involved in ground combat. But since then the nature of warfare has evolved, so that ground combat forces now make up only 16 percent of the armed forces. Meanwhile, changes in technology have led to a severe shortage in skilled technicians, trained pilots, computer analysts,mechanics,and others needed to operate sophisticated military equipment. Why has such a shortage developed, and why has the military been unable to keep its skilled personnel? A recent study provides some answers.[7]

The rank structure of the army has remained essentially unchanged over the years. Among the officer ranks, pay increases are determined primarily by the number of years of service. Consequently, officers with differing skill lev-

[7] See Walter Y. Oi, "Paying Soldiers: On a Wage Structure for a Large Internal Labor Market," unpublished, undated paper.

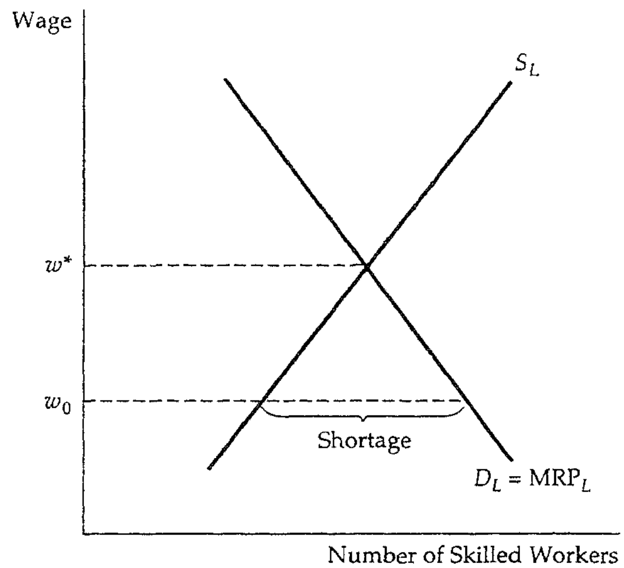

FIGURE 14.13 The Shortage of Skilled Military Personnel. When the wage w^* is paid to military personnel, the labor market is in equilibrium. When the wage is kept below w^*, at *wo,* however, there is a shortage of personnel because the quantity of labor demanded is greater than the quantity supplied.

els and abilities are usually paid similar salaries, and some skilled workers are anderpaid relative to what they could receive in the private Sector. As a result, skilled workers who join the army because of attractive salaries find that their marginal revenue products are eventually higher than their wages. Some remain in the army, but many leave.

Figure 14.13 shows the inefficiency that can result from the army's pay policy. The equilibrium wage rate w^* is the wage that equates the demand for labor to the supply. Because of inflexibility in its pay structure, however, the army pays the wage *wo,* which is below the equilibrium wage. At *wo,* demand is greater than supply, and there is a shortage of skilled labor. By contrast, competitive labor markets pay more productive workers higher wages than their less productive counterparts. But how can the army attract and keep its skilled labor force?

The army's choice of wage structureeffects the nation's ability ,to maintain an effective fighting force. In response to its personnel problems, the army has begun to change its salary structure by expanding the number and size of its reenlistment bonuses. Selective reenlistment bonuses targeted at skilled jobs for which there are shortages can be an effective recruiting device. The immediate bonuses create more of an incentive than the somewhat uncertain promise of higher wages in the future. As the demand for skilled military jobs increases, we can expect the army to make greater use of these reenlistment bonuses and other market-based incentives.

14.3 *Factor Markets with Monopsony Power*

In some factor markets, individual buyers of factors have monopsony power. For example, we saw in Chapter 10 that U.S. automobile companies have considerable monopsony power as buyers of parts and components. GM, Ford, and Chrysler buy large quantities of brakes, radiators, tires, and other parts and can negotiate lower prices than smaller purchasers might pay. Similarly, IBM has monopsony power in the market for disk drives because it purchases so many drives for its computers.

Throughout this section we will assume that the output market is perfectly competitive. Also, because a single buyer is easier to visualize than several buyers who all have some monopsony powel, we will restrict our attention to pure monopsony.

Marginal and Average Expenditure

When a firm buys a factor input in a competitive market, the marginal and average expenditure curves are identical. But when the firm is a monopsonist, the marginal and average expenditure curves are not the same, as Figure 14.14 shows.

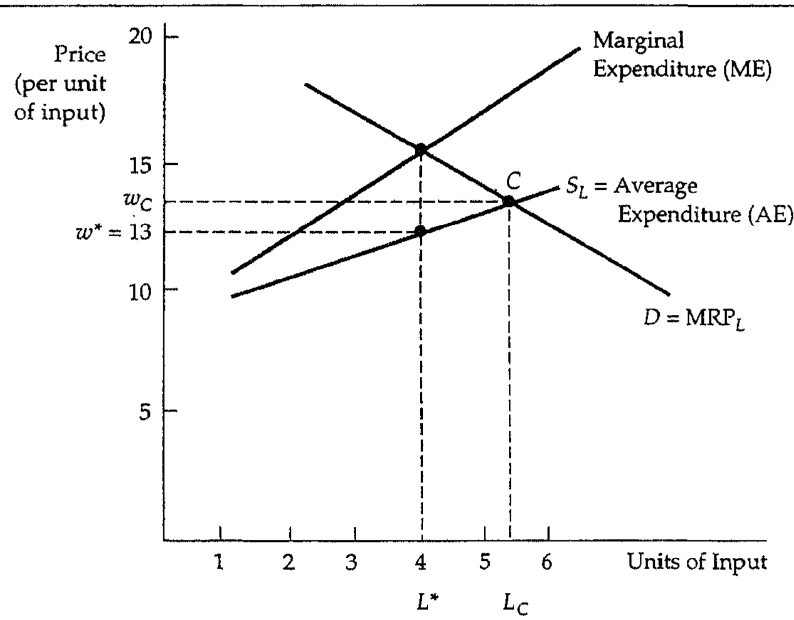

FIGURE 14.14 Marginal and Average Expenditure. When the buyer of an input has monopsony power, the marginal expenditure curve lies above the average expenditure curve because the firm raises the input price as more of the input is bought. The number of units of input purchased is given by L^*, at the intersection of the marginal revenue product and marginal expenditure curves. The corresponding wage rate w^* *is* lower than the competitive wage w_C.

The factor supply curve facing the monopsonist is the market supply curve. (It shows how much of the factor suppliers are willing to sell as the price of the factor increases.) Because the monopsonist pays the same price for each unit, the supply curve is its *average expenditure curve*. The average expenditure curve is upward sloping because the monopsonist must pay a higher price if it wants to buy more of the factor. For a profit-maximizing firm/ however, it is the *marginal expenditure curve* that is relevant in deciding how much of the factor to buy. Recall from Chapter 10 that the marginal expenditure curve lies above the average expenditure curve because when the firm increases the price of the factor to hire more units, the firm must pay *all* units that higher price, not just the last unit hired.

The Input Purchasing Decision of the Firm

How much of the input should the firm buy? It should buy up to the point where marginal expenditure equals marginal revenue product. Here the benefit from the last unit bought (MRP) is just equal to the cost (ME). Figure 14.14 illustrates this for a labor market. Note that the monopsonist hires L^* units of labor; at that point ME = MRP_L. The wage rate w^* that workers are paid is given by finding the point on the average expenditure or supply curve associated with L^* units of labor.

As we showed in Chapter 10, a buyer with monopsony power maximizes net benefit (utility less expenditure) from a purchase by buying up to the point where marginal value (MV) is equal to marginal expenditure:

$$MV = ME$$

For a firm buying a factor input, MV is just the marginal revenue product of the factor MRP So we have (just as in the case of a competitive factor market):

$$\boxed{ME = MRP} \tag{14.7}$$

Note from Figure 14.14 that the monopsonist hires less labor than a firm or group of firms with no monopsony power. In a competitive labor market, L_c workers would be hired because at that level the quantity of labor demanded (given by the marginal revenue product curve) is equal to the quantity of labor supplied (given by the average expenditure curve). Note also that the monopsonistic firm will be paying its workers a wage w^* that is less than the wage *We* that would be paid in a competitive market.

Monopsony power can arise in different ways. One source can be the specialized nature of a firm's business. If the firm buys a component that no other firm buys, it is likely to be a monopsonist in the market for that component. Another source of monopsony power in labor markets can be the business's location-it may be the only major employer within an area. Another source of monopsony power is an agreement among the buyers of a factor to form a cartel to limit purchases of the factor, so they can buy it at a price lower than the competitive price.

Few firms in our economy are pure monopsonists. But firms (or individuals) often have some monopsony power either because their purchases represent a substantial portion of the market, or because they have some advantage over other potential purchasers of the product. The government is a monopsonist when it hires volunteer soldiers or buys missiles, aircraft, and other specialized equipment for the army. A mining firm or other company that is the only major employer in a community also has monopsony power in the local labor market. Even in these cases, however, monopsony power may be limited because the government competes to some extent with other firms that offer similar jobs, and the mining firm competes to some extent with companies in nearby communities.

EXAMPLE 14.4 MONOPSONY POWER IN THE MARKET FOR BASEBALL PLAYERS

In the United States, major league baseball is exempt from the antitrust laws, the result of a Supreme Court decision and the policy of Congress not to apply the antitrust laws to labor markets.[8] This antitrust exemption allowed baseball team owners (before 1975) to operate a monopsonistic cartel. Like all cartels, this one depended on an agreement among owners. This agreement involved an annual draft of players and a *reserve clause* that effectively tied each player to one team for life, thereby eliminating most interteam competition for players. Under the reserve clause, once a player was drafted by a team, he could not play for another team unless rights were sold to that team. As a result, baseball owners had monopsony power in negotiating new contracts with their players-the only alternative to signing an agreement was to give up the game or play it outside the United States.

During the 1960s and early 1970s, baseball players' salaries were substantially below the market value of their marginal products (determined in part by the incremental attention that better hitting or pitching might achieve). For example, players receiving a salary of approximately $42,000 in 1969 would have received a salary of $300,000 were the players' marketperfectly competitive.

Fortunately for the players, and unfortunately for the owners, there was a strike in 1972 followed by a lawsuit by one player (Curt Flood of the St. Louis Cardinals) and an arbitrated labor-management agreement. This process eventually led in 1975 to an agreement by which baseball players could become free agents after playing for a team for six years. The reserve clause was no longer in effect, and a highly monopsonistic labor market became much more competitive.

The result was an interesting experiment in labor market economics. Between 1975 and 1980, the market for baseball players adjusted to a new post-

[8] This example builds on a recent analysis of the structure of baseball players' salaries by Roger Noll, who has kindly supplied us with the relevant data. See also G. W. Scully, "Pay and Performance in Major League Baseball/" *American Economic Review* 64 (Dec. 1974): 915-930.

reserve clause equilibrium. Whereas before 1975, expenditures on players' contracts made up approximately 25 percent of all team expenditures, by 1980 those expenditures had increased to 40 percent. Moreover, the average player's salary doubled in real terms. By 1992, the average baseball player was earning $1,014/942, an incredible increase from the monopsonistic wages of the late 1960s. (In 1969, for example, the average baseball salary was approximately $42,000. When adjusted for inflation this comes to approximately $160,000 in 1992.)

14.4 *Factor Markets with Monopoly Power*

Just as buyers of inputs can have monopsony power, sellers of inputs can have monopoly power. In the extreme, the seller of an input may be a monopolist, as when a firm has a patent to produce a computer chip that no other firm can duplicate. There are relatively few pure monopolies in factor markets, but in many industries firms have some monopoly power in the sale of products that other, firms will use as factors of production. Because the most important example of monopoly power in factor markets involves labor unions, we will concentrate most of our attention there. In the subsections that follow, we briefly describe how a labor union, which is a monopolist in the sale of labor services, might increase the well-being of its members and substantially affect nonunionized workers.

Monopoly Power over the Wage Rate

Figure 14.15 shows a demand for labor curve in a market with no monopsony power-it aggregates the marginal revenue products of firms that compete to buy labor. The labor supply curve describes how union members would supply labor *if* the union exerted no monopoly power. Then the labor market would be competitive, and L^* workers would be hired for a wage of w^*.

Because of its monppoly power, however, the union can choose any wage rate and the corresponding quantity of labor supplied (just as a monopolist seller of output chooses price and the corresponding quantity of output). If the union wanted to maximize the number of workers hired, it would choose the competitive outcome at A; However, if the union wished to obtain a higher than competitive wage, it could restrict its membership to L_1 workers. As a result, the firm would pay a wage rate of w_1 Those union members who work are better off, while those members who do not work are worse off.

Is a policy of restrictive union membership worthwhile? Yes, if the union wishes to maximize the economic rent that its workers receive. By restricting membership, the union would be acting like a monopolist that restricts output

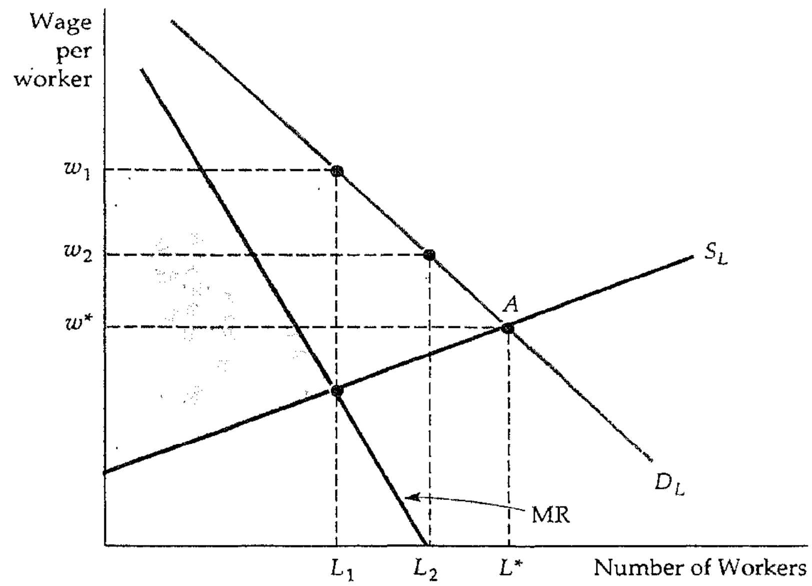

FIGURE 14.15 Monopoly Power of Sellers of Labor. When a labor union is a monopolist, it chooses among points on the buyer's demand for labor curve D_L. The seller can maximize the number of workers hired,at L^*, by agreeing that workers will work at wage w^*. The quantity of labor L_1 that maximizes the rent that employees earn is determined by the intersection of the marginal revenue and supply of labor curves; union members will receive a wage rate of w_1. Finally, if the union wishes to maximize total wages paid to workers, it should allow L_2 union members to be employed at a wage rate of w_2 because the marganal revenue to the union will then be zero.

to maximize profit. Profit to a firm is the revenue it receives less its opportunity costs. Rent to a union represents the wages its members earn in excess of their opportunity cost To maximize rent, the union must choose'the number of workers hired, so that the marginal revenue to the union (the additional wages earned) is equal to the extra cost of inducing the worker to -work. In Figure 14.15 this involves choosing the quantity of labor at which the marginal revenue curve MR crosses the supply curve (because the supply curve represents the opportunity cost of workers being employed). We have chosen the wage-employment combination of w_1 and L_1 with this in mind. The shaded area below the demand for labor curve, above the supply of labor curve and to the left of L_1, represents the economic rent that workers receive.

A rent-maximizing policy might benefit nonunion workers if they can find nonunion jobs. However, if these jobs are not available, rent maximization could create too sharp a distinction between winners and losers. An alternative objective is to maximize the aggregate wages that all workers receive. To achieve this goal, in the example in Figure 14.15, the number of workers hired is increased from L_1 until the marginal revenue to the union is equal to zero.

Because any further employment decreases total wage payments, aggregate wages are maximized when the wage is equal to w_2 and the number of workers is equal to L_2.

A Two-Sector Model of Labor Employment

When the union uses its monopoly power to increase its members' wages, fewer unionized workers are hired. Because these workers either move to the nonunion sector or choose not to join the union initially, it is important to understand what happens in the nonunionized part of the economy.

Assume that the total supply of unionized and nonunionized workers is fixed. In Figure 14.16 the market supply of labor in both sectors is given by S_L. The demand for labor by firms in the unionized sector is given by D_U, and the demand in the nonunionized sector by D_{NU}. The total market demand is the horizontal sum of the demands in the two sectors and is given by D_L.

Suppose the union chooses to increase the wage of its workers above the competitive wage w^*, to w_u. At that wage rate; the number of workers hired in the unionized sector falls by an amount ΔL_U, as shown on the horizontal axis. As these workers find employment in the nonunionized sector, the wage

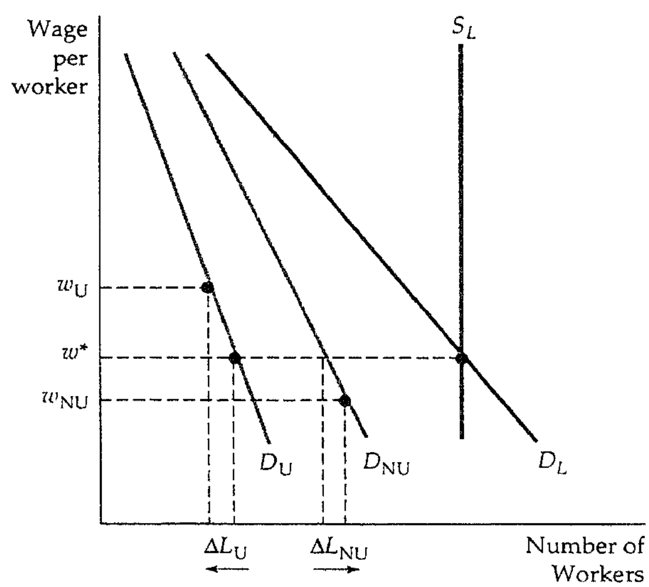

FIGURE 14.16 Wage Determination in. Unionized and Nonunionized Sectors. When a monopolistic union raises the wage in the. unionized sector of the economy from w^* to w_u employment in that sector falls, as shown by the movement along the demand curve D_u, For the total supply of labor, given by S_L, to remain unchanged, the wage in the nonunionized sector must fall from w^* to w_{NU}, as shown by the movement along the demand curve D_{NU}.

rate in the nonunionized sector adjusts until the labor market is in equilibrium. The new wage rate in the nonunionized sector, w_{NU}, was chosen so that the additional number of workers hired in the nonunionized sector, ΔL_{NU}, is equal to the number of workers who left the unionized sector.

Figure 14.16 shows an adverse consequence of a union strategy directed toward raising union wages-nonunionized wages fall. Unionization can improve working conditions arid provide useful information to workers and management. But when the demand for labor is not perfectly inelastic, union workers are helped at the expense of nonunion workers.

Bilateral Monopoly in the Labor Market

The adverse effects of union wage policies by a monopolistic union depend to some extent on our assumption that the input market is otherwise competitive. To see this, we now consider the consequences of union wage policies when the buyers of labor also have monopsony power.

As we discussed in Chapter 10, *bilateral monopoly is* a market in which a monopolist sells to a monopsonist In a labor market, bilateral monopoly might arise when representatives from a union and companies that hire a certain type of worker meet to negotiate wages. Figure 14.17 shows a typical bilateral bargaining situation. The S_L curve represents the supply curve for skilled labor, and the firm's demand curve for labor is given by the marginal revenue product curve D_L.

If the union had no monopoly power, the monopsonist would make its hiring decision on the basis of its marginal expenditure curve ME, choosing to hire 20 workers and paying them $10 per hour. When 20 workers are hired, the marginal revenue product of labor is equal to the marginal expenditure of the firm.

The seller of labor faces a demand curve D_L that describes the firm's hiring plans as the wage rate varies. The union chooses a point on the demand curve that maximizes its members' wages. Because the wage paid to all workers falls as the number hired increases, the marginal revenue curve MR describes the additional wages that the union gets for its members as the number of employees hired increases.

The supply curve S_L tells the union the minimum payment necessary to encourage workers to offer their labor to firms in the industry. Suppose the union wishes to maximize the economic rent of its members. To do so, the union views the supply curve as the marginal cost of labor. To maximize the rent that is earned, the union chooses a wage of $19 because $19 is the wage that equates the marginal revenue (the marginal increase in wages) to the marginal cost (the increase in the minimum wages needed to hire the labor). At $19, the firms would hire 25 workers.

In summary, firms are willing to pay a wage of $10 and hire 20 workers, but the union is demanding a wage of $19 and wants the firm to hire 25 workers. What happens in this case? The result depends on the bargaining strategies of the two parties. If the union can make a credible threat to strike, it might secure a wage closer to $19 than to $10. If the firms can make a credible threat

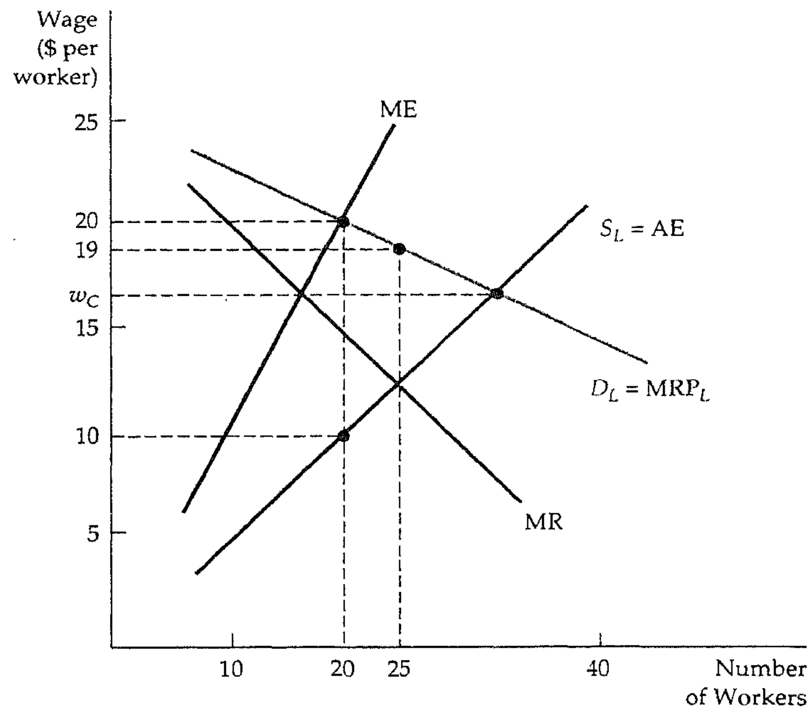

FIGURE 14.17 Bilateral Monopoly. When the seller of labor is a monopolist and the buyer of labor a monopsonist, the wage rate that is negotiated will be between a high of $19 (determined by the intersection of the marginal revenue and average expenditure curves) and a low of $10 (determined by the intersection of the marginal revenue product curve and marginal expenditure curves).

to hire nonunion labor, they might secure a wage closer to $10. If both parties can make credible threats, the resulting agreement might be close to the competitive outcome (wage *wc)* of about $15 in Figure 14.*17*.[9]

EXAMPLE 14.5 THE DECLINE OF PRIVATE SECTOR UNIONISM

For several decades, both the membership and bargaining power of labor unions have been declining.[10] A decline in union monopoly power can lead to different responses by union negotiators and can also affect the wage rate

[9] There is no guarantee .that monopoly power and monopsony power will cancel, nor that the total number of workers hired will be near the competitive level because both the monopolist and the monopsonist want to limit the number of workers hired. In "Unions and Monopoly Profits," *Review of Economics and Statistics* 67 (1985): 34-42, Thomas Karier shows that unions reduce profits in highly concentrated industries, but have little or no effect on profits in more competitive industries.

[10] This example is based on Richard Edwards and Paul Swaim, "Union-Nonunion Earnings Differentials and the Decline of Private-Sector Unionism," *American Economic Review* 76 (May 1986): 97-102.

and level of employment. During the 1970s most of the effect was on union wages: Levels of employment did not change much, but the differential between union and nonunion wages decreased substantially. We would have expected the same pattern to occur in the 1980s because of the heavily publicized wage freezes and the rapid growth of two-tier wage provisions, in which newer union members are paid less than their more experienced counterparts.

Surprisingly, however, the union-management bargaining process changed during this period. From 1979 to 1984, the level of unionized employment fell from 27.8 percent to 19.0 percent. Yet the union-nonunion wage differential remained relatively stable and in fact grew wider in some industries. For example, the union wage rate in mining, forestry, and fisheries declined only from 25 percent higher than the nonunion wage in 1979 to 24 percent higher in 1984. On the other hand, the union wage rate in manufacturing increased slightly from approximately 14 percent higher than the nonunion wage in 1979 to 16 percent in 1984. The same pattern has continued into the 1990s, with unionized employment at 16 percent in 1991, and the union-nonunion wage differential essentially unchanged.

One explanation for this pattern of wage-employment responses is a change in union strategy-a move to maximize the individual wage rate rather than the total wages paid to all union members. However, the demand for unionized employees has probably become increasingly elastic over time as firms find it easier to substitute capital for skilled labor in the production process. Faced with an elastic demand for its services, the union would have little choice but to maintain the wage rate of its members and allow employment levels to fall substantially. Of course, the substitution of nonunion for union workers may cause further losses in the bargaining power of labor unions. How this will affect the differential between union and nonunion wages remains to be, seen.

Summary

1. In a competitive input market, the demand for an input is given by the marginal revenue product, the product of the firm's marginal revenue and the marginal product of the input.

2. A firm in a competitive labor market will hire workers to the point at which the marginal revenue product of labor is equal to the wage rate. This is analogous to the profit-maximizing output condition that production be increased to the point at which marginal revenue is equal to marginal cost.

3. The market demand for an input is the horizontal sum of the industry demands for that input. Industry demand, however. Is not the horizontal sum of the demands of all the firms in the industry. An appropriate determination of industry demand must take into account that the market price of the product will change in response to the change in the price of an input.

4. When factor markets are competitive, the buyer of an input assumes that its purchases will have no effect on the price of the input. As a result, the marginal expenditure and avera&e expenditure curves that the firm faces are both perfectly elastic.

5. The market supply of a factor such as labor need not be upward sloping. A backward-bending labor supply curve can result if the income effect associated with a higher wage rate (more leisure is demanded because leisure is a normal good) is greater than the substitution effect (less leisure is demanded because the price of leisure has gone up).

6. Economic rent is the difference between the payments to factors of production and the minimum payment that would be needed to employ those factors. In a labor market, rent is measured by the area below the wage level and above the marginal expenditure curve.

7. When a buyer of an input has monopsony power, the marginal expenditure curve lies above the average expenditure curve, which reflects that the monopsonist must pay a higher price to attract more of the input into employment.

8. When the input seller is a monopolist such as a labor union, the seller chooses the point on the marginal revenue product curve that best suits its objective. Maximization of employment, economic rent, and wages are three plausible objectives for labor unions.

9. When a monopolistic union bargains with a monopsonistic employer, the wage rate depends on the nature of the bargaining process. There is little reason to believe that the competitive outcome will be achieved.

Questions for Review

1. Why is a firm's demand for labor curve more inelastic when the firm has monopoly power in the output market than 'when the firm is. producing competitively?

2. Why might a labor supply curve be backward bending?

3. How is a computer company's demand for computer programmers a derived demand?

4. Compare the hiring choices of a monopsonistic and a competitive employer of workers. Which will hire more workers, and which will pay the higher wage? Explain.

5. Rock musicians sometimes earn more than $1 million per year. Can you explain this large income in terms of economic rent?

6. What happens to the demand for one input when the use of a complementary input increases?

7. For a monopsonist, what is the relationship between the supply of an input and the marginal expenditure on that input?

8. Currently the National Football League has a system for drafting college players by which each player is picked by only one team and must sign with that team or not play in the league. What would happen to the wages of newly drafted and more experienced football players if the draft system were repealed, so that all teams could compete for college players?

9. Why are wages and employment levels indeterminate when the union has monopoly power and the firm has monopsony power?

Exercises

1. Workers whose incomes are less than $10,000 currently pay no federal income taxes. Suppose a new government program guarantees each worker $5000, whether or not he. or she earns any income. For all earned income up to $10,000, the worker must pay a 50 percent tax to the government. Draw the budget line facing the worker under this new program. How is the program likely to affect the labor supply curve of workers?

2. Using your knowledge of marginal revenue product, explain the following:

a. A famous tennis star is paid $100,000 for appearing in a 30-second television commercial. The actor who plays his doubles partner is paid $500.

b. The president of an ailing savings and loan is paid *not* to hold office for the last two years of his contract.

c. A jumbo jet carrying 400 passengers is priced higher than a 250-passenger model even though both aircraft cost the same to manufacture.

3. The demands for the factors of production listed below have increased.' What can you conclude about changes in the demands for the related consumer goods? If demands for the consumer goods remain unchanged, what other explanation is there for an increase in derived demands for these items?

a. computer memory chips

b. jet fuel for passenger planes

c. paper used for newsprint

d. aluminum used for beverage cans

4. Suppose there are two groups of workers, unionized and nonunionized. Congress passes a law that requires all workers to join the union. What do you expect to happen to the wage rates of formerly nonunionized workers and those workers who were originally unionized? What have you assumed about the union's behavior?

5. Suppose a firm's production function is given by $Q = 12L - L^2$, for $L = 0$ to 6, where L is labor input per day, and Q is output per day. Derive and draw the firm's demand for labor curve if the output sells for $10 in a competitive market. How many workers will the firm hire when the wage rate is $30 per day? $60 per day? (Hint: The marginal product of labor is $12 - 2L$)

6. The only legal employer of military soldiers in the United States is the federal government. If the government uses its knowledge of its monopsonistic position, what criteria will it employ when figuring how many soldiers to recruit? What happens if a mandatory draft is implemented?

7. The demand for labor by an industry is given by the curve $L = 1200 - 10w$, where L is the. labor demanded per day, and w is the wage rate. The supply curve is given by $L = 20w$. What is the equilibrium wage rate and quantity of labor hired? What is the economic rent earned by workers?

8. This exercise is a continuation of Exercise 7. Suppose now that the only labor available is controlled by a monopolistic labor union that wishes to maximize the rent that union, members earn. What will be the quantity of labor employed and the wage rate? How does your answer compare with your answer to exercise 7? Discuss. (Hint: The union's marginal revenue curve is given by $L = 600 - 5w$.)