

Factor Markets

Introduction (1/2)

In Chapter 6, we saw how firms choose the optimal mix of labor and capital inputs to produce their desired output, given the prices of labor and capital and the firm's production function. Now, we will examine how these prices are determined in **factor markets**.

Chapter Outline

- 13.1 Demand in a Perfectly Competitive Factor Market
- 13.2 Supply in a Perfectly Competitive Factor Market
- 13.3 Labor Market Equilibrium
- 13.4 The Labor Market in the Long Run
- 13.5 Other Perfectly Competitive Factor Markets
- 13.6 Imperfectly Competitive Factor Markets: Monopsony, a Monopoly in Factor Demand
- 13.7 Imperfectly Competitive Factor Markets: Monopoly in Factor Supply
- 13.8 Bilateral Monopoly
- 13.9 Conclusion

Introduction (2/2)

A firm minimizes its production costs by hiring the input mix that equates the marginal rate of technical substitution to the input price ratio.

How are input prices determined?

- Examine the markets for inputs, or factors of production, that are used to produce outputs.
 - Factor Markets
- Use the supply and demand model framework.
 - Relevant prices are the wage rate and the prices of materials, service, energy, and land.
- We begin by analyzing perfectly competitive factor markets.

Demand in a Perfectly Competitive Factor Market (1/12)

13.1

The labor market is one of the most important **factor markets**.

- In most economies, about 60% to 70% of the money spent on inputs is paid to workers.

The Firm's Demand for Labor

- The demand side of the labor market comprises all firms that would like to hire workers.
 - Examine the demand for labor for a single firm.
 - Sum across all firms to obtain the market demand for labor.
- Simplifying assumptions
 - All labor units, or workers, are the same.
 - Firms choose the amount of labor to hire in the short run.

Demand in a Perfectly Competitive Factor Market (2/12)

A firm faces tradeoffs when it hires more labor.

- Adding workers enables more output.
 - Recall the additional production from a 1-unit increase in labor is the marginal product of labor (MP_L).
 - The additional revenue from selling 1 additional unit of output is marginal revenue (MR).

Increasing production is useful only when product can be sold.

- The **marginal revenue product of labor (MRP_L)** is the total benefit of adding 1 worker.
 - The number of products that worker makes multiplied by the revenue earned by selling the product:

$$MRP_L = MP_L \times MR$$

Demand in a Perfectly Competitive Factor Market (3/12): Question 1

The last worker a firm hires produces 5 more units of the firm's product, which it sells for \$100 per unit. The marginal revenue product of labor for the last worker hired is:

- A. \$5.
- B. \$100.
- C. \$200.
- D. \$500.

Demand in a Perfectly Competitive Factor Market (3/12):

Question 1 – Correct Answer

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- B. \$100.
- C. \$200.
- D. \$500. (correct answer)**

Demand in a Perfectly Competitive Factor Market (4/12)

Consider how the benefit (MRP_L) and cost (W) of labor changes with the amount of labor employed.

- The firm can hire additional labor at the market price of W , which is unaffected by the amount of labor hired.
- Labor's marginal revenue product *falls* as more labor is used.
 - A firm's production exhibits *diminishing marginal returns* to labor (and capital).
 - For example, the MP_L decreases as firms hire more labor.
 - Marginal revenue (MR) is constant in perfect competition and equal to the market price of the product.

As production increases, the MP_L falls and the MR is unaffected, causing the MRP_L to fall.

What if the firm has market power?

- Marginal revenue falls as output increases.
- Since more labor must be used to produce more output, the fall in MR will also serve to decrease the MRP_L .

Demand in a Perfectly Competitive Factor Market (5/12)

The Firm's Labor Demand: A Graphical Approach

Again, consider the tradeoff between the benefit (MRP_L) and the cost (W) of hiring more labor.

- At relatively low levels of hiring, the MRP_L is high because the MP_L is large.
 - When $MRP_L > W$, firms will want to hire more labor, as the benefit is greater than the cost.
- As hiring increases, the MP_L falls, causing the MRP_L to fall.
 - A firm will not hire past the point where the cost (W) exceeds the benefit (MRP_L).
 - It will not hire additional workers when $MRP_L < W$.

The optimal amount of labor is employed when $MRP_L = W$.

Demand in a Perfectly Competitive Factor Market (6/12): Question 2

The marginal product of labor of the last worker a firm hired is 10 units of product, and the firm sells its product for \$15 a unit. If the current wage is \$115, which of the following statements is true?

- A. The firm has hired the optimal number of workers.
- B. The firm has hired too many workers; the cost exceeds the benefit.
- C. The firm should hire another worker if this worker has a marginal product of labor equal to eight or more.
- D. The firm should hire another worker if this worker has a marginal product of labor equal to six or more.

Demand in a Perfectly Competitive Factor Market (6/12):

Question 2 – Correct Answer

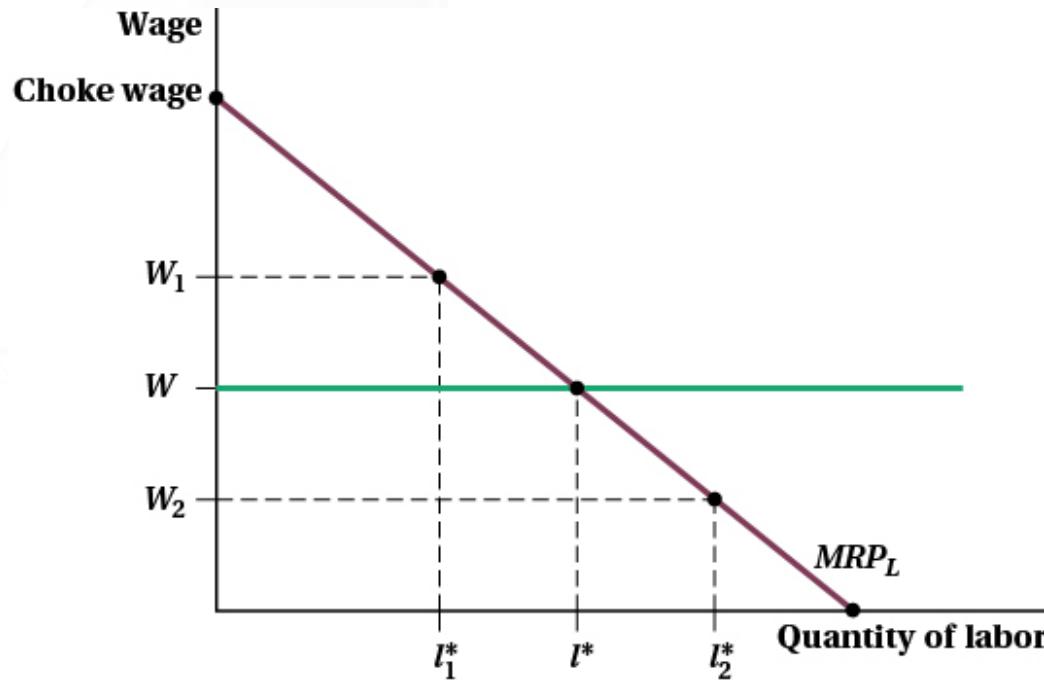
13.1

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- D. The firm should hire another worker if this worker has a marginal product of labor equal to six or more.

Demand in a Perfectly Competitive Factor Market (7/12)

Figure 13.2 The Marginal Revenue Curve Is the Labor Demand Curve



- If the market-determined wage increased to W_1 , fewer units of labor would be hired (l_1^*).
- If the market-determined wage decreased to W_2 , more workers would be hired (l_2^*).

- **Choke wage:** the wage at which a firm will not want to hire any labor

Demand in a Perfectly Competitive Factor Market (8/12)

Rearranging the optimal hiring condition:

$$MRP_L = MP_L \times MR = W \quad \rightarrow \quad MR = \frac{W}{MP_L}$$

At the firm's optimal hiring level, marginal revenue equals wage divided by the marginal product of labor.

- Implies that producing the profit-maximizing quantity ($MR = MC$) also means the firm hires the optimal amount of labor.

The connection between a firm's output and its optimal labor hiring implies that labor demand is a **derived demand**.

- A demand for one product (labor) arises from the demand for another product (the firm's output).

Demand in a Perfectly Competitive Factor Market (9/12): Question 3

A firm has hired the optimal amount of labor with the marginal product of labor of the last worker equal to 10 units. If the wage is \$120, what is the marginal revenue earned from the last worker hired?

- A. \$10
- B. \$12
- C. \$110
- D. \$120

Demand in a Perfectly Competitive Factor Market (9/12): Question 3 – Correct Answer

A firm has hired the optimal amount of labor with the marginal product of labor of the last worker equal to 10 units. If the wage is \$120, what is the marginal revenue earned from the last worker hired?

- A. \$10
- B. \$12 (correct answer)
- C. \$110
- D. \$120

Demand in a Perfectly Competitive Factor Market (10/12)

Shifts in the Firm's Labor Demand Curve

Forces that influence either the marginal product of labor or the marginal revenue will shift the labor demand curve (MRP_L).

Marginal Product of Labor

- Depends on both the production function and the firm's amount of capital.
 - Example: An increase in total factor productivity (*technical change*) will shift the MP_L outward, which would shift the labor demand curve outward.

Marginal Revenue

- Relationship between MR and shifts in the MRP_L is the result of the labor demand being a derived demand.
- If the demand for the firm's product falls, the price will fall, which will cause the marginal revenue to fall along with it.
 - If fewer people demand their product, the firm will hire fewer workers.

Demand in a Perfectly Competitive Factor Market (11/12)

Market Labor Demand Curve

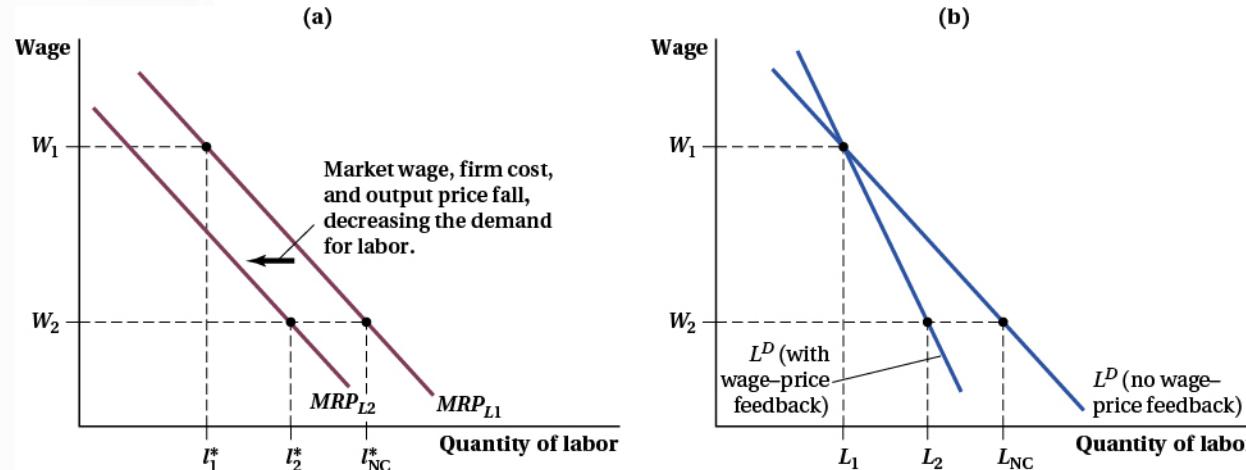
The market demand for labor is the horizontal sum of all the individual firms' labor demand curves.

The Market Wage and the Price of the Firms' Output

- A drop in the market wage decreases the costs of all firms in the industry.
- The price of the industry output drops.
 - The price drop reduces the firms' marginal revenue curve, shifting the MRP_L inward.
- As a result, the firms' total response to a change in the market wage will be *smaller* than if there were no connection between the market wage and the output price.

Demand in a Perfectly Competitive Factor Market (12/12)

Figure 13.4 Industry Labor Demand



- (a)
- An Industry firm has an initial labor demand curve of MRP_{L1} .
 - A fall in the market wage from W_1 to W_2 reduces all industry firms' costs and the output price.
 - The lower price reduces marginal revenue and shifts the firm's labor demand to MRP_{L2} .
 - The firm will increase labor hiring from L_1^* to L_2^* .
- (b)
- At the market level, this feedback between the market wage and the output price implies that a wage drop from W_1 to W_2 increases the quantity of labor demanded for L_1 to *only* L_2 .
 - With no feedback, an increase of L_1 to L_{NC} would be expected.

Supply in a Perfectly Competitive Factor Market (1/10)

13.2

In a perfectly competitive market, the firm can hire as much labor as it wants at the market wage.

- It faces a perfectly elastic supply of labor at the market wage.
 - All shifts in the firm's labor demand show up as changes in quantity of labor demanded rather than as wage changes.
- The supply of labor available to firms depends on the willingness of people to work.
 - Willingness to work depends on age, family situation, health, and so on.

We will focus on the effect of the wage on the quantity of labor supplied while holding all other things constant.

- Later, we'll examine how willingness to work changes when wage changes.

Supply in a Perfectly Competitive Factor Market (2/10)

13.2

Work, Leisure, and Individual Labor Supply

A key to grasping how wage affects people's labor supply is to understand how they think about leisure.

- Assume people view leisure as a good, such as a shirt or a car.
- If leisure is a good, what is its price?
 - Leisure takes time, so the price is what that person could be doing with that time.

We assume that a person who isn't working is at leisure.

- By choosing leisure instead of work, they are giving up income, so the price of leisure can be thought of as an individual's wage.

Supply in a Perfectly Competitive Factor Market (3/10)

Work, Leisure, and Individual Labor Supply: Example

Marissa can choose either work or leisure.

- The benefit of working is increased ability to buy and consume goods.
- By choosing leisure, she gives up that increase.

We can think of her labor supply as a choice between consuming leisure and consuming the goods and services that can be bought with her income from work.

- Treat everything she can buy as one good.
 - Call this consumption, with its quantity measured in dollars.
 - The relative price between leisure and consumption is wage.
 - Example: If an individual's wage is \$30 an hour, an hour of leisure costs \$30 worth of consumption.

Supply in a Perfectly Competitive Factor Market (4/10)

13.2

Work, Leisure, and Individual Labor Supply: Example

Use utility theory, from Chapter 4, to analyze the choice between work and leisure.

- Marissa gets utility from both leisure and consumption.
- She can work only 24 hours in a day.
 - If she doesn't work at all, she earns nothing and spends 24 hours at leisure.
 - If she works constantly, she earns $W \times 24$ and has no leisure.
 - **For each hour she works, she gives up W , so the slope of her budget constraint will be equal to $-W$.**

Marissa maximizes her utility subject to a budget constraint for which the relative price of leisure is her wage.

Supply in a Perfectly Competitive Factor Market (5/10)

13.2

Income and Substitution Effects of a Change in Wages

Higher wages have two effects on consumption and leisure choices.

1. Leisure has a higher price relative to consumption.
 - The *substitution effect* pushes an individual to choose less leisure (work more) and consume more goods and services.
2. For any given level of work, it raises income.
 - If leisure is a normal good, the *Income effect* will push an individual to choose more leisure as income rises.

These are the same two effects of price changes we saw in Chapter 4.

Supply in a Perfectly Competitive Factor Market (6/10)

13.2

Income and Substitution Effects of a Change in Wages

The substitution effect of a wage change is what identifies an individual's labor supply curve.

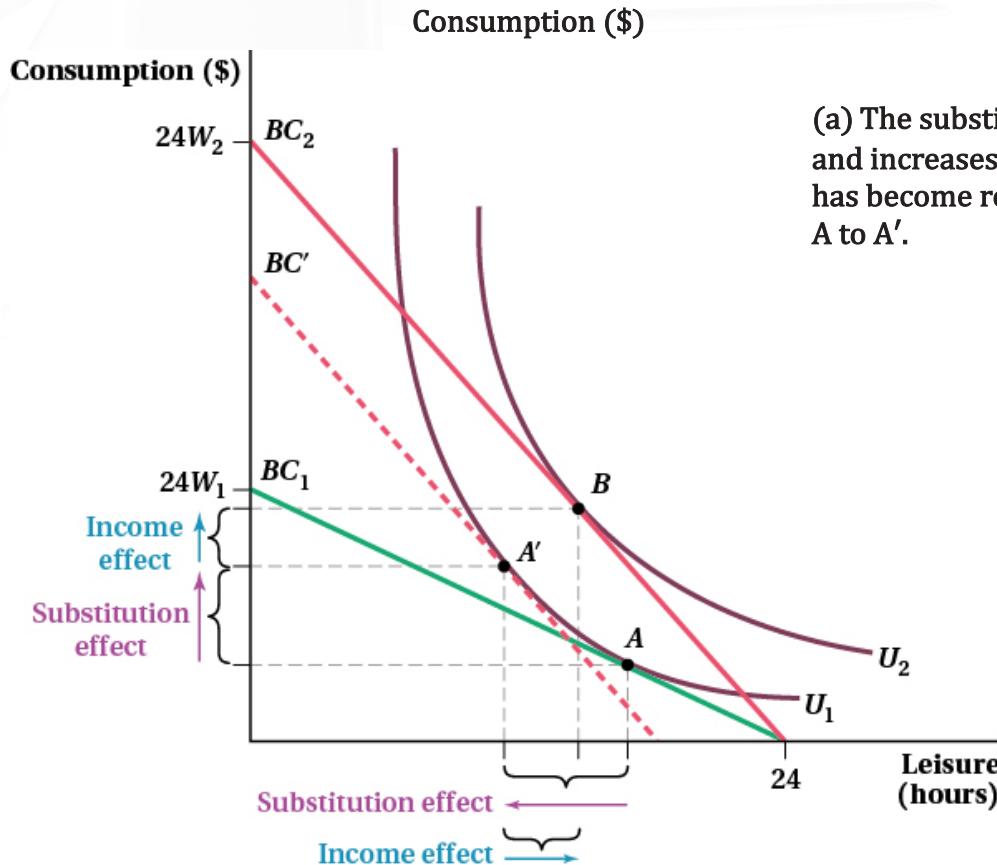
- It shows how much a person is willing to work at any given wage level.

Identifying the Substitution Effect

- Identify the optimal consumption–leisure bundle if *only* relative prices changed.
- Use a budget constraint that is parallel to the new budget constraint, post wage increase, but tangent to the original indifference curve.
 - Use the process that is discussed extensively in Chapter 5.

Supply in a Perfectly Competitive Factor Market (7/10)

Figure 13.5 The Consumption-Leisure Choice



(a) The substitution effect decreases leisure and increases consumption because leisure has become relatively more expensive A to A' .

(b) The income effect, shown by the tangency of the new budget constraint and the original indifference curve, increases leisure and work A' to B .

Supply in a Perfectly Competitive Factor Market (8/10)

13.2

The difference between the income and substitution effects is the net effect of a wage change on how much someone works.

- Generally, the substitution effect is larger than the income effect, and as a result of a wage increase, an individual chooses to work more.

However, if the income effect is large enough, you could see an individual work less as wage increases.

- The result is a backward-bending labor supply curve.

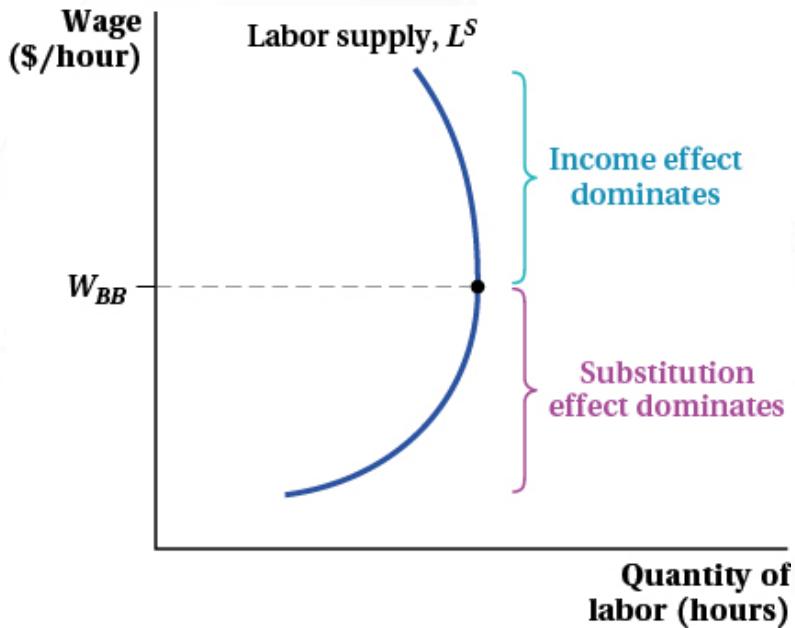
Examples:

- Low-wage workers tend to work more as wages increase.
- Very high wage workers might work less as wage increases.
 - Why?

Supply in a Perfectly Competitive Factor Market (9/10)

13.2

Figure 13.6 Backward-Bending Labor Supply



Initially, as wage increases, the substitution effect is larger than income effect.

- Result: increase in the number of hours worked

Once wage reaches W_{BB} , the income effect dominates and individuals choose more leisure rather than work.

- Result: decrease in the number of hours worked

Supply in a Perfectly Competitive Factor Market (10/10)

13.2

Market-Level Labor Supply

The market-level supply curve shows the total amount of labor all workers are willing to supply at every possible wage.

- Horizontal sum of every worker's labor supply curve
- To construct it, simply fix wage and add each worker's quantity of labor supplied at that wage.
 - Once this is done for every possible wage, the market-level labor supply is the result.
- While some individuals can have a backward-bending portion of their labor supply curve, research suggests that, at the market level, the substitution effect dominates the income effect.
 - The market labor supply curve is upward sloping.

Labor Market Equilibrium (1/2)

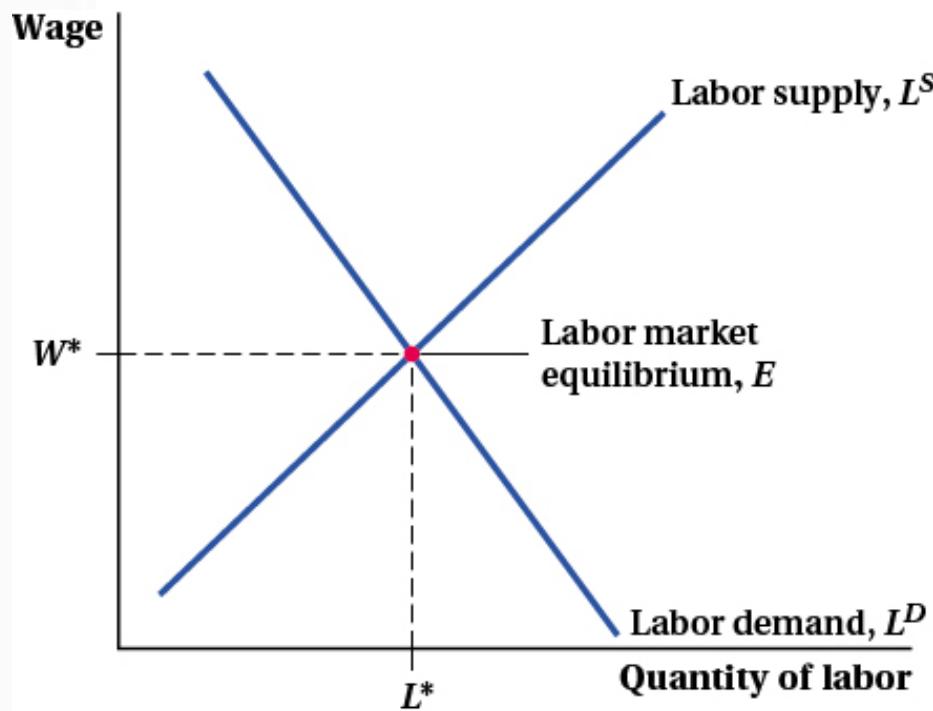
The labor market reaches equilibrium when the wage equates the quantity of labor demanded by firms and the quantity of labor supplied by workers.

- Each firm takes the wage as given and hires labor until its marginal revenue product of labor equals wage.
- The MRP_L varies across firms because of differing production functions, amounts of capital, and demand for their output.

The market equilibrium is the sum of all firms' hiring (L^*) at the equilibrium wage (W^*).

Labor Market Equilibrium (2/2)

Figure 13.7 Labor Market Equilibrium



The Labor Market in the Long Run (1/4)

13.4

Until this point, our analysis has focused on the short run, when capital is fixed.

What happens when a firm can change its capital level?

- Changes in the amount of a firm's capital alter its marginal product of labor (MP_L), which shifts the short-run labor demand curve.

i. Increase in capital

- Raises the MP_L (from Chapter 6)
- This increases the quantity demanded of labor at each wage.

Result: The firm's short-run labor demand curve shifts out.

ii. Decrease in capital

- Lowers the MP_L (from Chapter 6)

Result: the firm's short-run labor demand curve shifts in.

The Labor Market in the Long Run (2/4)

13.4

Suppose there is a permanent drop in the market equilibrium wage.

Short run: capital is fixed.

- i. When the wage drops, the firm hires more labor until the MRP_L equals the lower wage (l_1 to l_2 ; Shown in Figure 13.8).

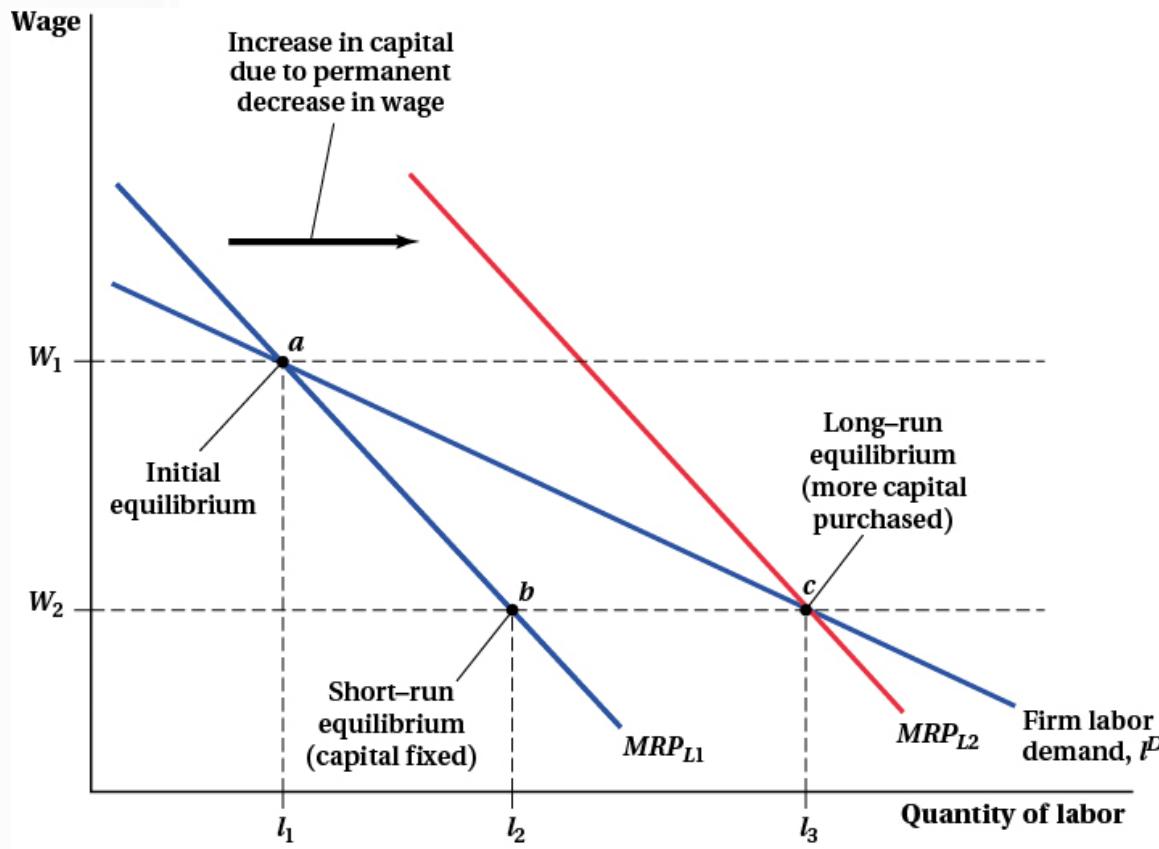
Long run: the firm can adjust capital.

- ii. The increase in labor from the short-run increase the marginal product of capital
 - Recall from Chapter 6 that increasing the use of one input increases the marginal product of the other.
- iii. The increase in the marginal product of capital gives the firm an incentive to employ more capital.
 - This shifts the MRP_L outward, and the firm hires more labor (l_2 to l_3 ; Shown in Figure 13.8).

The Labor Market in the Long Run (3/4)

13.4

Figure 13.8 Short-Run and Long-Run Labor Demand



The Labor Market in the Long Run (4/4)

13.4

When wages decrease:

- The use of labor in the long run is greater than in the short run.
 - The long-run labor demand curve is flatter than in the short run.
- Firms' hiring is more responsive to wage changes in the long run than the short run.
 - In the short run, a firm might hire temporary or part-time workers if it believes the wage might go up.
 - If it thinks the lower wage will persist, it will be more likely to hire employees full-time.

What happens when wages increase?

- In the long run, less labor is used than in the short run.
- More people are fired in the long run.

Other Perfectly Competitive Factor Markets (1/4)

13.5

In this section, we investigate other factor markets.

- Capital is the most prominent, but any input firms use in production are bought and sold in factor markets.

Other examples:

- Intermediate materials
 - Leather to make shoes or gloves
 - Lumber to make tables or chairs
 - Steel to make cars
- Business services
- Energy
- Land

Other Perfectly Competitive Factor Markets (2/4)

Demand in Other Factor Markets

The demand for any factor is similar to that for labor.

1. A firm's demand for any factor is given by the marginal revenue product (MRP_f) of that factor.
2. A factor's MRP falls as more of it is bought.
3. The optimal quantity of a factor is purchased by a firm such that its MRP equals the market price.
4. Total market demand is the horizontal quantity of each firm's individual demand.

Other Perfectly Competitive Factor Markets (3/4)

13.5

Supply in Other Factor Markets

The supply of a factor comes from producers or owners of those factors.

Intermediate goods: products that are made specifically to be used as a factor input in the production of another good

- The supply of an intermediate good is just as for other products.
- As price increases, producers of the factor are willing and able to supply more of the good, and vice versa.
- The equilibrium price is where quantity demanded equals quantity supplied.

Other Perfectly Competitive Factor Markets (4/4)

13.5

Supply in Other Factor Markets

Land is an interesting factor market.

Unimproved land: the physical space on which economic activity takes place: agriculture, housing, manufacturing, and so on

- Different from other factors because supply is essentially fixed
- The supply curve is perfectly inelastic, or vertical.
 - Changes in demand for it affect only the equilibrium price, since quantity is fixed.

Land *for any particular use*, however, is NOT fixed.

- For example, if the price of crops rises, you would expect people to begin to cultivate land that wasn't previously used for farming.

What if the price of crops falls? The demand to live in the area increases?

- Land previously used for farming could be developed for housing.

Imperfectly Competitive Factor Markets: Monopsony, a Monopoly in Factor Demand (1/9)

13.6

Thus far, we have restricted our attention to perfectly competitive factor markets.

What happens when factor demanders or suppliers are not price takers?

- Chapters 9 to 11 focused on how markets work when sellers have monopoly power.
- The buyer side is important in factor markets.
 - When the size of a buyer's order affects the market price of that product, the buyer is said to have **monopsony power**.

Firms with monopsony power:

- Pepsi and Coca-Cola
- Target and Walmart
- Apple and Samsung

Imperfectly Competitive Factor Markets: Monopsony, a Monopoly in Factor Demand (2/9)

13.6

Marginal Expenditure

A monopsonist is a buyer of inputs with market power.

- Because it is such a large buyer, the monopsonist faces a dilemma in that it influences price as it demands more product.
 - In other words, it faces an upward-sloping supply curve.

We can think about the firm's decision in terms of **marginal expenditure (ME)**.

- The incremental expenditure of buying one more unit of a product
 - Constant and equal to the market price for firms without market power

For monopsonists, demand is large enough to require the market price to rise as they purchase more.

- Marginal expenditure equals the price plus the incremental price it has to pay for all other previously purchased units.

Imperfectly Competitive Factor Markets: Monopsony, a Monopoly in Factor Demand (3/9)

13.6

Marginal Expenditure: Example

Initially, Syncrude hires 1,000 employees at \$50,000 each.

Syncrude's payroll = \$50 million

If it hired 1,100 employees, the added demand would push the wage up to \$60,000.

Syncrude's new payroll = \$66 million

Marginal expenditure of 100 workers = \$16 million

Imperfectly Competitive Factor Markets: Monopsony, a Monopoly in Factor Demand (4/9)

13.6

Just as the marginal revenue differs from the price for a monopoly supplier, marginal expenditure differs from the price for a monopsony buyer.

- The direction of the difference is opposite.
 - Marginal revenue is always less than price for a monopolist.
 - Marginal expenditure is always more than the price for a monopsonist.

Mathematically

- Marginal expenditure equals price plus the amount that price changes from increasing the quantity multiplied by the quantity.

$$ME = P + (\Delta P / \Delta Q) \times Q$$

Imperfectly Competitive Factor Markets: Monopsony, a Monopoly in Factor Demand (5/9)

13.6

Factor Demand with Monopsony Power

The optimal amount of inputs for a price-taking buyer is found by equating the marginal revenue product to the marginal expenditure.

- Condition holds for monopsonists
 - If a monopsonist buys more of an input than the $MRP = ME$ amount, the additional amount the monopsonist spends to buy those inputs will exceed the revenues it earns from them, and vice versa.

Only when $MRP = ME$ is a monopsonist buying the profit-maximizing amount of inputs.

Imperfectly Competitive Factor Markets: Monopsony, a Monopoly in Factor Demand (6/9)

13.6

Factor Demand with Monopsony Power

- Caution: ME is not the same for a monopsonist as it is for a price-taking buyer.

$$ME_{\text{price taker}} = P$$

$$ME_{\text{monopsonist}} = P + (\Delta P / \Delta Q) \times Q$$

$$ME_{\text{monopsonist}} > ME_{\text{price taker}}$$

- As a result, for the same MRP and input supply curves, a monopsonist will buy *fewer* inputs than a price-taking firm.
 - In this way, a monopsonist restricts purchases just as a monopolist restricts sales.

Imperfectly Competitive Factor Markets: Monopsony, a Monopoly in Factor Demand (7/9)

13.6

Equilibrium for a Monopsony

The same three-step procedure as for monopoly power is used to find the equilibrium of a market with monopsony power.

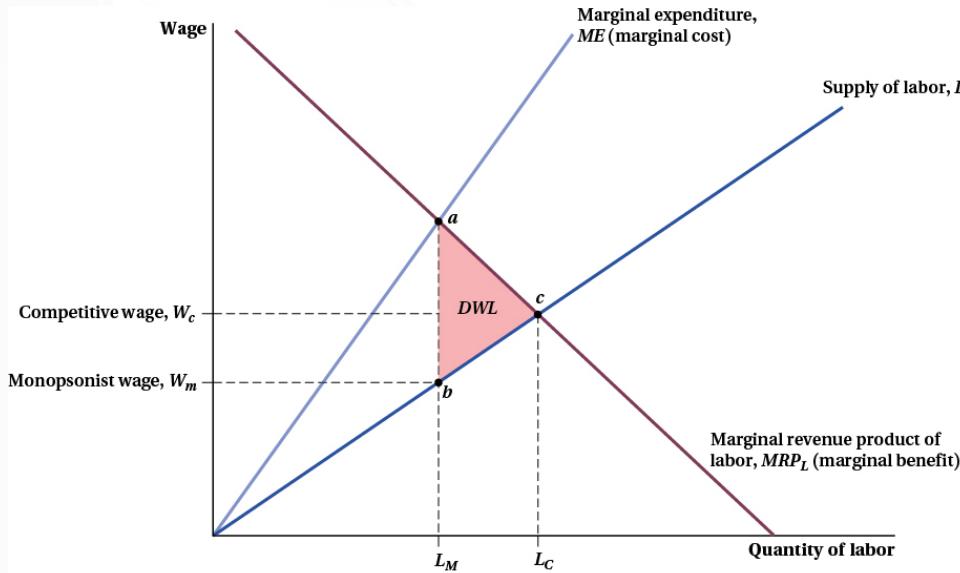
1. Derive the ME curve from the supply curve facing the buyer.
 2. Find the optimal quantity by setting $ME = MR$.
 3. Jump down to the supply curve at that quantity to determine the price paid for the factor.
-
- Monopsony power results in a smaller quantity of the input being hired or purchased and at a lower price than would be found in a competitive market.
 - This results in deadweight loss, just as with monopoly power.

Imperfectly Competitive Factor Markets: Monopsony, a Monopoly in Factor Demand (8/9)

13.6

Figure 13.11 A Monopsonist's Hiring Decision

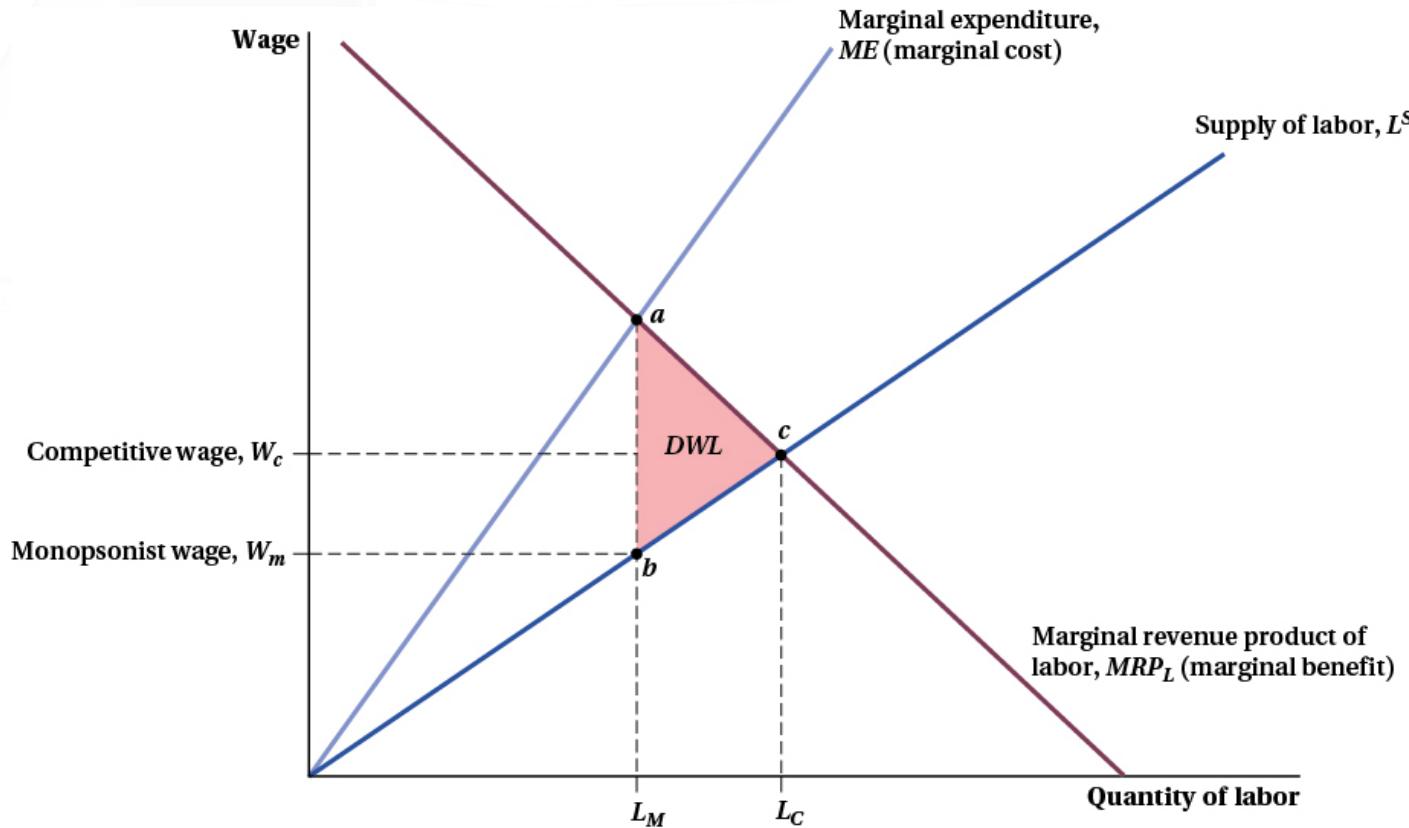
1. Plot the marginal expenditure curve, ME , that corresponds to the supply curve.
 - Since the supply curve is linear, we know it is twice as steep.
2. Find the optimal quantity of labor by identifying when $ME = MRP_L$.
 - Point a on the graph with the optimal labor being L_m
3. Identify the wage by seeing what wage must be paid to supply that much labor.
 - Point b on the graph with the wage is W_m



Imperfectly Competitive Factor Markets: Monopsony, a Monopoly in Factor Demand (9/9)

13.6

Figure 13.11 A Monopsonist's Hiring Decision



Imperfectly Competitive Factor Markets: Monopoly in Factor Supply (1/2)

13.7

In Chapters 9 and 10, we covered markets with monopoly power.

- These concepts apply to factor markets in which sellers have market power.
 - Example: An accountant has market power because he knows certain tricks or loopholes that others don't.
 - He can restrict provision of services (sales) relative to the competitive market because he knows that he drives down the price of his service by selling too much of it.
 - He could also try using price discrimination.
- Market power of factor suppliers is the same as the market power of a supplier of any good or service.

Imperfectly Competitive Factor Markets: Monopoly in Factor Supply (2/2)

13.7

Labor Markets and Unions

Labor unions are the most studied holders of market power in factor markets.

- Unions coordinate labor supply actions of their members so that these workers act together as a monopoly seller of labor.
 - Examples of unions: American Federation of Teachers, International Brotherhood of Teamsters, American Federation of State, County and Municipal Employees, United Steelworkers
- The union's coordination gives it market power, so the demand for its members' labor is downward-sloping.
- Economists generally assume unions maximize their workers' earnings.
 - Workers' earnings are maximized when the marginal revenue (its marginal wage earnings when it adds another member) equals zero.
- **The union will supply less labor for a higher wage than would be obtained in a competitive market.**

Bilateral Monopoly (1/1)

A major concentration of market power on both the supply and demand side of the market is called a **bilateral monopoly**.

- Models of market power discussed previously assume that only one side of the market has pricing power.
- In this case, it is uncertain which model should be used to figure out what will happen in a factor market or what either party should do.
 - Anything between a monopoly outcome and a monopsony outcome could be observed.

The outcome in these situations comes down to negotiations and bargaining.

- The game theory used in Chapter 12 can be useful in these situations.

Conclusion (1/1)

This chapter examined the markets for factors, goods that firms use as inputs to production.

- Wages for labor
- Rent for land and/or capital

These markets are similar to other markets we have examined, where demand and supply interact to determine an equilibrium quantity and price.

- Unique in that demand for outputs for facts is a *derived demand*

In **Chapter 14**, we will examine the role of microeconomics as it pertains to investment, time, and insurance.