

How Many Workers Should a Firm Hire?

You are the president of Acme Yo-Yo Company, a small manufacturing firm that produces Supersonic Yo-Yos, a popular toy that makes a “supersonic” noise when used.

- Acme yo-yos are produced by workers operating with two yo-yo-making machines. You have estimated how many yo-yos can be made using different numbers of workers and you must decide how many workers to hire to maximize your firm’s total profit.
 - Acme is a perfect competitor in the product market. This means your firm can sell as many yo-yos as you want at the market price of a yo-yo.
 - Acme also is a perfect competitor in the labor resource market. This means you can hire as many workers as you want at the market wage.
 - You will hire each worker who adds more to your firm’s total revenue than he/she adds to your total cost. You will not hire a worker who adds less to total revenue than to total cost.
 - Marginal physical product (MPP) is the change in your firm’s total output (Q) from adding an extra worker: $MPP = \Delta Q / \Delta L$, where L stands for labor.
 - Marginal revenue product (MRP) is the change in your firm’s total revenue (TR) from adding an extra worker: $MRP = \Delta TR / \Delta L$. Because you can sell all the yo-yos you want at the market price (P), $MRP = (MPP)(P \text{ of a yo-yo})$.
 - Marginal resource cost (MRC) is the change in your firm’s total cost (TC) from adding an extra worker: $MRC = \Delta TC / \Delta L$. Because you can hire all the workers you want at the market wage, $MRC = \text{Wage}$.
 - The profit-maximizing rule for an employer is to hire the number of workers at which $MRP = MRC$. This means the employer hires those workers with $MRP > MRC$ and stops before hiring workers with $MRP < MRC$. (If this rule sounds familiar, it uses the same logic as the $MR = MC$ rule a firm uses to find its profit-maximizing amount of output.)
- ! **Student Alert:** Some textbooks use marginal factor cost (MFC) or marginal labor cost (MLC) instead of marginal resource cost (MRC).

Part A: Creating the Firm's Demand for Labor



Table 4-1.1

Productivity and Revenue Data for Yo-Yo Workers

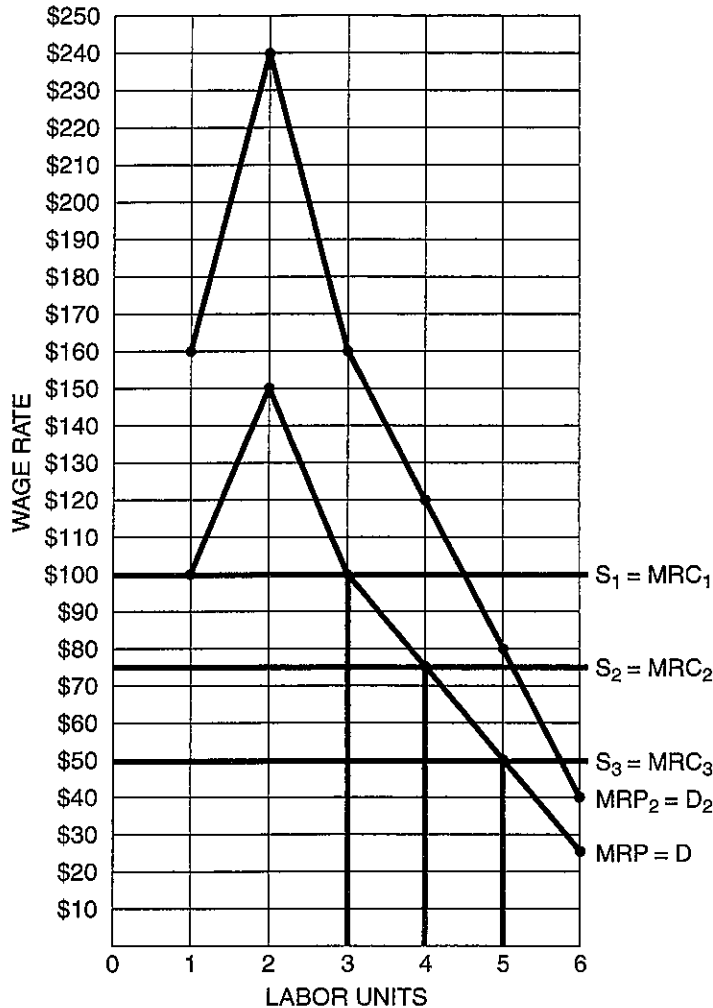
L (workers per day)	Q (yo-yos per day)	MPP	P	TR	MRP
0	0	–	\$5	\$0	–
1	20	+20	\$5	\$100	+\$100
2	50	+30	\$5	\$250	+\$150
3	70	+20	\$5	\$350	+\$100
4	85	+15	\$5	\$425	+\$75
5	95	+10	\$5	\$475	+\$50
6	100	+5	\$5	\$500	+\$25

1. Complete Table 4-1.1. Assume the market price of a yo-yo is \$5.
2. Why does the number of extra yo-yos produced by an additional worker decrease as more workers are added? Is it because the additional workers are less motivated and less talented than previous workers?
MPP gets smaller due to the principle of diminishing marginal productivity, which says that as a firm adds more workers to a fixed amount of equipment, eventually the MPP diminishes. This is caused by the limited amount of capital and not because some workers are lazy or untrained. Economists assume the firm has homogeneous (identical) labor units.
3. Plot the MRP values in Figure 4-1.1. Connect those values and label the curve as “MRP.” Plot each MRP value on the higher of the two L values, not at the midpoint. For example, plot the MRP value of \$150 at L = 2 rather than at L = 1.5.



Figure 4-1.1

The Acme Firm's Demand for Labor and Supply of Labor



4. If the market wage is \$100 per worker per day, your firm can hire all the workers it wants at that wage. This means the supply of labor to your firm can be shown as a horizontal line at the wage of \$100. Draw a horizontal line in Figure 4-1.1 at \$100 and label the line as " $S_1 = MRC_1$." The MRC to the firm of each extra worker is equal to the wage of \$100.

5. At a wage of \$100, how many workers should your firm hire? Why?

The firm will hire 3 workers at a wage of \$100. The first worker has $MRP = \$100$, the second has $MRP = \$150$, and the third has $MRP = \$100$. Because the fourth worker has MRP of only \$75, that worker will not be hired at a wage of \$100.

6. Now assume the market wage drops to \$75. Draw a new horizontal line at that wage and label it as " $S_2 = MRC_2$." How many workers will be hired at the wage of \$75?

The firm will hire four workers at a wage of \$75.

7. Finally, assume the market wage is \$50. Draw another horizontal line at that wage and label it as " $S_3 = MRC_3$." How many units of labor will be hired at the wage of \$50?

The firm will hire five workers at a wage of \$50.

8. The firm's demand for labor shows how many workers it will hire at different wages. Complete Table 4-1.2 based on your work above.



Table 4-1.2

Acme's Demand for Labor

Wage	Number of workers hired
\$100	3
\$75	4
\$50	5

9. If a firm hires labor in a perfectly competitive factor market, then the downward sloping portion of its MRP curve is its demand (D) curve for labor. If the wage is equal to the MRC, then by going to its MRP curve at a given wage, the firm finds the amount of labor where $MRP = MCL$. Go back to Figure 4-1.1 and label the MRP curve as " $MRP = D$."
10. Is the law of demand evident in Table 4-1.2? Why does a firm hire more workers when the wage decreases?
- Yes. As the wage decreases, the firm increases the number of workers it wishes to hire. A lower wage makes additional workers profitable.*

Part B: The Derived Demand for Labor

We saw in Part A that if a firm operates in perfectly competitive resource markets, its demand for labor is its MRP curve. So what can increase the firm's demand for labor? Remember how we calculate MRP if the product market is perfectly competitive: $MRP = (MPP)(\text{price of the good})$. An increase in the MPP of labor or an increase in the price of the good will increase the MRP of labor, thus increasing the firm's demand for labor. A decrease in the marginal physical product or a decrease in the good's price will reduce the demand for labor.

11. In Table 4-1.3, indicate for each situation whether the product or labor market is being affected, whether the MPP of labor or the price (P) of the good will change, and whether the demand for labor will increase or decrease.



Table 4-1.3

Factors Changing a Firm's Demand for Labor

Situation	Which market?	Change in MPP?	Change in P?	Change in demand for labor
(A) A new yo-yo machine increases productivity of labor.	<i>Product / Labor</i>	<u>Yes</u> / No	Yes / <u>No</u>	<u>Increase</u> / Decrease
(B) The price of yo-yos increases.	<u>Product</u> / Labor	Yes / <u>No</u>	<u>Yes</u> / No	<u>Increase</u> / Decrease
(C) New government safety regulation reduces worker productivity.	<i>Product / Labor</i>	<u>Yes</u> / No	Yes / <u>No</u>	Increase / <u>Decrease</u>
(D) The demand for yo-yos decreases.	<u>Product</u> / Labor	Yes / <u>No</u>	<u>Yes</u> / No	Increase / <u>Decrease</u>
(E) New technology increases output of yo-yos.	<i>Product / Labor</i>	<u>Yes</u> / No	Yes / <u>No</u>	<u>Increase</u> / Decrease
(F) Consumers become tired of yo-yos.	<u>Product</u> / Labor	Yes / <u>No</u>	<u>Yes</u> / No	Increase / <u>Decrease</u>

The demand for any resource is called a *derived demand* because it is derived from the demand for the good or service that is produced by the resource. It is important that you understand the relationship between demand in the factor market and demand in the product market. (Even if you are a charming individual, unless you produce a good or service that is in demand, you will find it hard to land a good job.)

12. Assume that yo-yos become a hot fad and the increased demand for them drives the market price of a yo-yo up to \$8. Complete Table 4-1.4, which has the same productivity data as Table 4-1.1.



Table 4-1.4
Productivity and Revenue Data for Yo-Yo Workers

L (workers per day)	Q (yo-yos per day)	MPP	P	TR	MRP
0	0	–		\$0	–
1	20	+20	\$8	\$160	+\$160
2	50	+30	\$8	\$400	+\$240
3	70	+20	\$8	\$560	+\$160
4	85	+15	\$8	\$680	+\$120
5	95	+10	\$8	\$760	+\$80
6	100	+5	\$8	\$800	+\$40

13. Plot the new MRP data in Figure 4-1.1 and label it as “ $D_2 = MRP_2$.” Does this represent an increase in Acme’s demand for labor? What caused it?

This is an increase in the demand for labor caused by an increase in the price of the good that labor is producing. The productivity of labor is unchanged but the value of the MPP has increased because of the higher price of yo-yos.

14. Based on your new MRP_2 curve in Figure 4-1.1, fill in Table 4-1.5.

Because of the increase in labor’s MRP, Acme will increase the number of workers hired at wages of \$100 and \$75. It still hires 5 workers at a wage of \$50 because the MRP of the sixth worker is still less than \$50.



Table 4-1.5
Acme’s New Demand for Labor

Wage	Number of workers hired
\$100	4
\$75	5
\$50	5

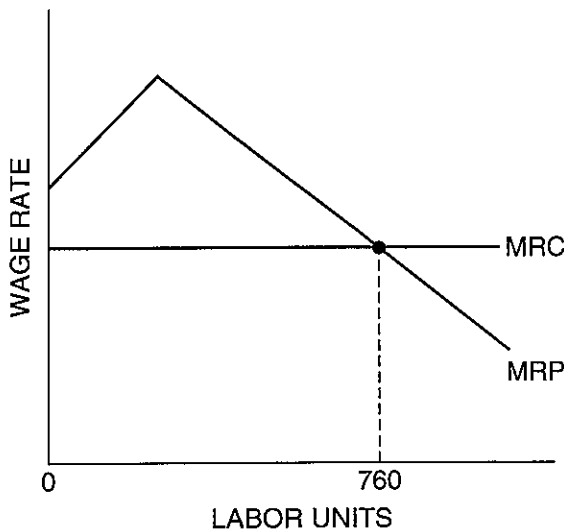
Part C: How Many Workers to Hire?

Figure 4-1.2 shows the MRP curve and the MRC curve for a company that sells its product in a perfectly competitive goods market and hires its labor in a perfectly competitive resource market.

15. You tell your friend that this firm should hire 760 units of labor because that is where $MRP = MRC$. Your friend is confused and asks how this firm can maximize total profit with 760 labor units since the marginal profit from the 760th labor unit appears to be \$0. Can you help your friend understand the logic of the $MRP = MRC$ rule?



Figure 4-1.2
Logic of the $MRP = MRC$ Rule



Yes, the marginal profit of the 760th worker is \$0 because for that worker we see that $MRP = MRC$. But by hiring 760 workers, the firm hired the first 759 workers. And each of them had $MRP > MRC$, which means they each created positive marginal profit for the firm, thus increasing the firm's total profit. By stopping with the 760th unit, the firm did not hire workers with $MRP < MRC$ because they would have negative marginal profit, which would decrease the firm's total profit. The " $MRP = MRC$ " rule is a handy tool that identifies the amount of labor needed to maximize the firm's total profit.

The Optimal Combination of Resources

In Activity 4-1, we assumed the Acme Yo-Yo Company was operating in the short run with a fixed amount of capital (equipment) and with labor as its variable resource. Let's now consider a long-run example where the firm can change its capital as well as its labor. What combination of labor (L) and capital (K) should the firm employ?

Part A: The Least-Cost Combination of Resources

What should a firm do if it wants to produce the most output possible from a given resource budget? What should it do if it wants to produce a given level of output at the lowest total cost? The approach to both of these problems is similar. The firm should allocate its resource budget between units of labor and units of capital in such a way that the following condition is satisfied, where marginal physical product is MPP and marginal resource cost is MRC:

$$\frac{\text{MPP}_L}{\text{MRC}_L} = \frac{\text{MPP}_K}{\text{MRC}_K}$$

If the resource markets are perfectly competitive, the price the firm pays for an extra unit of a resource is equal to its MRC. In that case the condition can be written as

$$\frac{\text{MPP}_L}{P_L} = \frac{\text{MPP}_K}{P_K}$$

where P_L is the price of a unit of labor and P_K is the price of a unit of capital.

Another way of stating this condition for *economic efficiency* is that the firm should get the same extra output from the last dollar spent on each type of resource.

Assume a firm has allocated its given resource budget between labor and capital and finds the marginal physical product for the resources to be 200 units from labor and 400 units from capital. That means the last unit of labor increased total output by 200 units while the last unit of capital increased output by 400 units. At first glance, you might think the firm should move some money away from labor and over to capital. But that would totally ignore the prices of the two resources. Assume the prices of labor and capital in competitive resource markets are \$10 and \$40, respectively.

1. Calculate the "MPP per \$1" for each resource.

$$\text{Labor: } \frac{200 \text{ units}}{\$10} = 20 \text{ units per } \$1. \quad \text{Capital: } \frac{400 \text{ units}}{\$40} = 10 \text{ units per } \$1.$$

2. Based on your work in Question 1, is the firm getting the most output possible from its given resource budget? If so, explain why. If not, how should it reallocate its budget between labor and capital?

No, the firm can do better. It should spend more of its budget on labor and less on capital. Labor is giving more output per \$1 on the margin than is capital.

3. Suppose the MPP values are as given in Question 1, but that the prices of labor and capital are \$10 and \$20, respectively. Is the firm now getting the most output possible from its resource budget? Explain.

$$\text{Labor: } \frac{200 \text{ units}}{\$10} = 20 \text{ units per } \$1. \quad \text{Capital: } \frac{400 \text{ units}}{\$20} = 20 \text{ units per } \$1.$$

The firm is getting the most output possible from its resource budget. If it moved a dollar from one resource to the other, there would be no net change in output.

4. A different firm has allocated its resource budget between labor and capital and is producing a given output level at the lowest possible total cost. The MPP of labor is 25 units, and the MPP of capital is 20 units. If the price of a unit of labor is \$100, what is the price of a unit of capital? *Since we know the firm is using the least-cost combination of resources, we can solve for the price of capital:*

$$\frac{25 \text{ units}}{\$100} = \frac{20 \text{ units}}{P_K} \quad (25 \text{ units})(P_K) = \$2,000 \quad P_K = \$80.$$

Part B: The Profit-Maximizing Combination of Resources

The economic efficiency condition in Part A is what economists call a “necessary but not sufficient” condition for profit maximization. In other words, if a firm is not using an economically efficient (least-cost) combination of resources, then it cannot possibly be maximizing its total profit. If it is using an economically efficient combination, then it might be profit maximizing, but an additional condition must be satisfied to guarantee that is the case.

Here is the profit-maximizing condition for a combination of two resources:

$$\frac{MRP_L}{MRC_L} = \frac{MRP_K}{MRC_K} = 1.$$

If the resource markets are perfectly competitive, the condition can be written as

$$\frac{MRP_L}{P_L} = \frac{MRP_K}{P_K} = 1.$$

While this condition looks similar to the one in Part A, there are two significant differences.

1. The firm is comparing MRP, not MPP, to MRC.
2. The two ratios must both be equal to 1.

The second difference means the MRP from the last unit of each resource must be equal to its MRC. If the MRP of a unit of labor is greater than its MRC, the firm should hire more labor. If the MRP of a unit of capital is less than its MRC, the firm should get rid of some capital. (This is the rule we used in Activity 4-1 to find the profit-maximizing amount of labor in the short run when capital was fixed: Hire the amount of labor where $MRP = MCL$.)

5. Suppose the Ebbets Company produces 1,000 units of output with a combination of labor and capital such that the MRP of labor is \$30 and the MRP of capital is \$40. If this firm is maximizing its total profit at this output, what are the prices of units of labor and capital? (Assume the firm buys resources in perfectly competitive markets.)

$$\frac{\$30}{P_L} = \frac{\$40}{P_K} = 1.$$

The price of labor is \$30 and the price of capital is \$40.

6. The Shibe Company produces 800 units of output per period. The MRP of labor is \$60, and the MRP of capital is \$40. The market prices of units of labor and capital are \$12 and \$8, respectively. Is this firm maximizing its total profit? Explain.

$$\text{Labor: } \frac{\$60}{\$12} = \frac{\$5}{\$1} \quad \text{Capital: } \frac{\$40}{\$8} = \frac{\$5}{\$1}$$

No, it is not maximizing its total profits. Since the MRP from each resource exceeds the price (MRC) of that resource, the firm should hire more of each resource and expand its output. Don't be fooled by the fact that in this example the two ratios are equal. The point is that both ratios are greater than 1, which means the firm should employ more labor and more capital.

7. The Honus Company currently produces Q_1 units of output each period. It sells its good in a perfectly competitive product market and buys its resources in perfectly competitive factor markets. The MPP of labor is 50 units, and the MPP of capital is 80 units. The prices it pays for units of labor and capital are \$100 and \$160, respectively.

- (A) Is the company operating in an economically efficient manner? Explain.

$$\text{Labor: } \frac{50 \text{ units}}{\$100} = 0.5 \text{ units per } \$1. \quad \text{Capital: } \frac{80 \text{ units}}{\$160} = 0.5 \text{ units per } \$1.$$

Yes, the firm is economically efficient. It is producing its output Q_1 at the lowest possible total cost.

- (B) What would the market price of its good have to be for the firm to be maximizing its total profit?

Since it is using an economically efficient combination of resources, the firm might be maximizing its total profit. For profit-maximization to occur, the firm must use a combination of resources such that $MRP_L = P_L$ and $MRP_K = P_K$

$$\begin{array}{ll} MRP_L = P_L & MRP_K = P_K \\ (MPP_L)(P_{good}) = P_L & (MPP_K)(P_{good}) = P_K \\ (50 \text{ units})(P_{good}) = \$100 & (80 \text{ units})(P_{good}) = \$160 \\ P_{good} = \$2.00 & P_{good} = \$2.00 \end{array}$$

For profit-maximization, the price of its good would have to be \$2.00.

The least-cost and profit-maximization conditions also apply to a firm with more than two resources (W, X, and Y).

Least-cost combination:
$$\frac{MPP_W}{MRC_W} = \frac{MPP_X}{MRC_X} = \frac{MPP_Y}{MRC_Y}.$$

Profit-maximization combination:
$$\frac{MRP_W}{MRC_W} = \frac{MRP_X}{MRC_X} = \frac{MRP_Y}{MRC_Y} = 1.$$

The Only Game in Town

In Activity 4-1, we assumed the Acme Yo-Yo Company sold its product in a perfectly competitive market. Acme could sell all the yo-yos it wanted at the price determined in the market. Now, let's suppose that Acme is a monopolist and controls the yo-yo market. Because it still hires its workers in a perfectly competitive labor market, we will continue to treat its marginal revenue product (MRP) curve as its demand for labor (L). It can hire all the workers it wants at the market wage rate.

What is different in our analysis if Acme is a monopolist in the product market rather than a perfectly competitive seller of yo-yos? The difference is that now the firm must lower its price to sell more yo-yos. That will create a wedge between its price and the marginal revenue it receives from an extra sold unit. And it will make the workers' MRP decrease faster than it did when the firm was perfectly competitive. Now there are two reasons why MRP decreases as more workers are hired: diminishing marginal productivity and diminishing marginal revenue.

Part A: Creating the Monopolist's Demand for Labor

1. Complete Table 4-3.1, which shows the prices at which the Acme monopolist can sell the different quantities of yo-yos it is producing. You can see that the firm must lower the price to sell more of its product. The productivity data are the same as they were in Activity 4-1; the fact that the firm now has no competition in the product market does not affect the productivity of workers.


 **Student Alert:** You cannot find the MRP of a worker by multiplying the marginal physical product (MPP) by the price (P). That worked in Activity 4-1 because the firm sold its output (Q) at the market price. But now the firm is a monopolist and must lower price to sell more output. MRP is found here as the change in total revenue (TR) when the firm adds an extra worker.



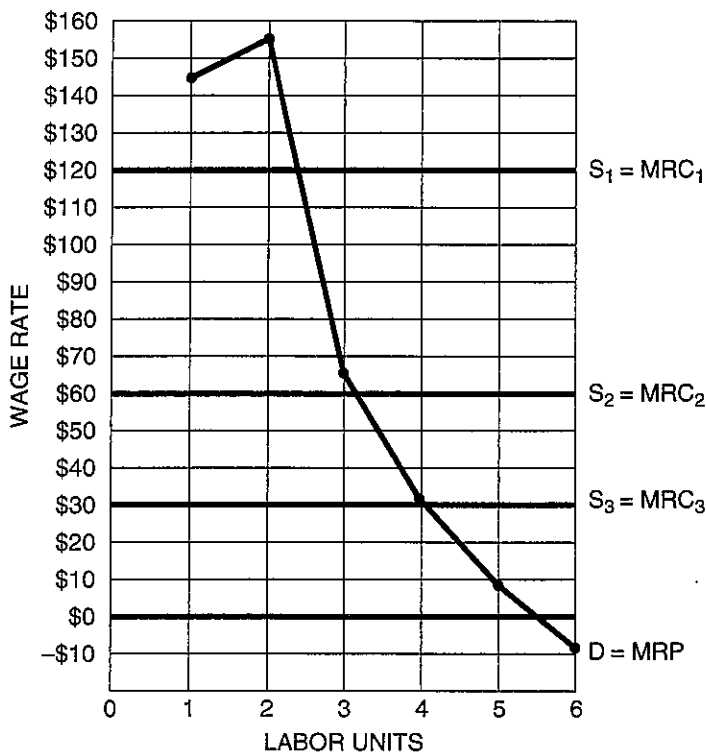
Table 4-3.1
Productivity and Revenue Data for Yo-Yo Workers

L (workers per day)	Q (yo-yos per day)	MPP	P	TR	MRP
0	0	–	\$8.00	\$0	–
1	20	+20	\$7.25	\$145.00	+\$145.00
2	50	+30	\$6.00	\$300.00	+\$155.00
3	70	+20	\$5.25	\$367.50	+\$67.50
4	85	+15	\$4.70	\$399.50	+\$32.00
5	95	+10	\$4.30	\$408.50	+\$9.00
6	100	+5	\$4.00	\$400.00	–\$8.50

- Plot the firm's MRP data in Figure 4-3.1. Connect the MRP values and label the curve as "D = MRP." Plot the MRP values at the new labor amount rather than at the midpoint.



Figure 4-3.1
The Acme Firm's Demand for Labor and Supply of Labor



- Draw three horizontal labor supply curves in Figure 4-3.1 at wages of \$120, \$60, and \$30. Label them as "S₁ = MRC₁," "S₂ = MRC₂," and "S₃ = MRC₃."
- Complete Table 4-3.2, which shows how many workers the firm will hire at each of these wages. *The firm will hire each unit of labor for which MRP is greater than or equal to MRC.*



Table 4-3.2
Acme's Demand for Labor

Wage	Number of workers hired
\$120	2
\$60	3
\$30	4

5. Does the law of demand apply to this firm, which is a monopolist in the product market?

Yes. This firm, like any other firm, will hire more workers if the wage is reduced.

6. Why can we consider the firm's MRP curve as its labor demand curve? Is it important that the labor market is perfectly competitive? Is it important that the product market is not perfectly competitive?

A demand curve shows how many units of an item are demanded at different prices. Since this firm buys labor in a perfectly competitive factor market, it can get all the workers at the market wage. This means the wage is equal to the firm's marginal resource cost. At any wage, it can go horizontally out to the MRP curve to find the optimal number of workers to hire. The fact that it is a monopolist in the product market does not play a role in stating that the MRP curve is the firm's demand for labor.

7. Other things being equal, would Acme's demand curve for labor be steeper or flatter now than it was when it was in a perfectly competitive goods market? Why?

It will be steeper because there now are two reasons why MRP decreases as more workers are added: (1) diminishing marginal productivity from extra labor units, and (2) diminishing marginal revenue from extra output units. When the product market was perfectly competitive, the only reason MRP decreased as more labor was hired was diminishing marginal productivity.

Factor Market Pricing

A perfectly competitive labor market determines the equilibrium wage and employment in that market. Firms that buy labor in this market will pay the market wage and can hire all the workers they want at this wage. This activity demonstrates how the market wage is set and how a firm interacts with the labor market.

Part A: Labor Demand for the Perfectly Competitive Firm

The Awesome Belt Company (ABC) is a price taker in both the input and output markets. It hires labor in a perfectly competitive resource market and sells its belts in a perfectly competitive product market. The total revenue (TR) the firm receives from each amount of labor is found by multiplying output (Q) by the price (P) at which that level of output can be sold. The marginal revenue product (MRP) of an extra unit of labor is the change in TR resulting from the firm adding the extra labor unit.

1. Complete Table 4-4.1 based on two different possible prices for ABC's belts.



Table 4-4.1

ABC's Productivity and Revenue Data

Labor (L)	Output (Q)	Marginal physical product (MPP) ($\Delta Q/\Delta L$)	Price = \$2.00		Price = \$3.00	
			TR	MRP	TR	MRP
0	0	–	\$0	–	\$0	–
1	10	+10	\$20	+\$20	\$30	+\$30
2	30	+20	\$60	+\$40	\$90	+\$60
3	70	+40	\$140	+\$80	\$210	+\$120
4	105	+35	\$210	+\$70	\$315	+\$105
5	135	+30	\$270	+\$60	\$405	+\$90
6	160	+25	\$320	+\$50	\$480	+\$75
7	180	+20	\$360	+\$40	\$540	+\$60
8	195	+15	\$390	+\$30	\$585	+\$45
9	205	+10	\$410	+\$20	\$615	+\$30
10	205	+0	\$410	+\$0	\$615	+\$0
11	195	–10	\$390	–\$20	\$585	–\$30

2. Now complete Table 4-4.2 and Table 4-4.3, which show ABC's demand for labor at two different prices of belts. The demand schedules indicate the highest wage the firm will pay for a given number of workers, based on the MRP of workers in Table 4-4.1.



Table 4-4.2

ABC's Demand for Labor if the Price of Belts Is \$2.00

Wage	Quantity of labor demanded
\$20	9
\$30	8
\$40	7
\$50	6
\$60	5
\$70	4
\$80	3



Table 4-4.3

ABC's Demand for Labor if the Price of Belts Is \$3.00

Wage	Quantity of labor demanded
\$30	9
\$45	8
\$60	7
\$75	6
\$90	5
\$105	4
\$120	3

Part B: The Perfectly Competitive Labor Market

3. Assuming there are 1,000 firms identical to ABC in the belt industry, complete Table 4-4.4, based on the market price of belts being \$2.00. Since the firms are identical, you can simply multiply the quantity of labor demanded by ABC at the different wages by 1,000 to derive the market demand for labor. Table 4-4.4 also has information about the number of workers willing to supply their labor at the different wages. Comparing the quantity of workers demanded and the quantity supplied, indicate whether there is a shortage or a surplus of labor at each wage. One wage is the equilibrium wage in the market.



Table 4-4.4

The Labor Market Based on the Price of Belts Being \$2.00

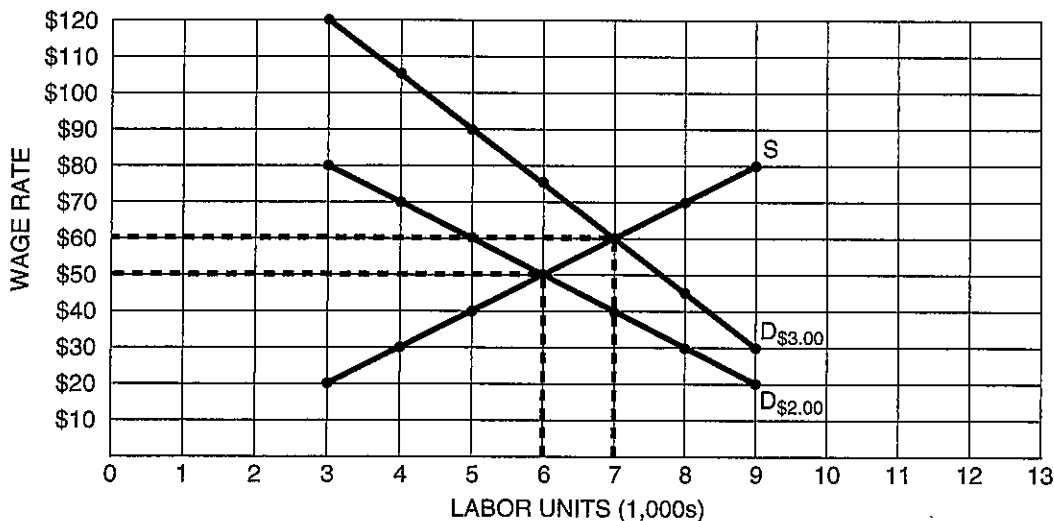
Wage	Quantity of labor demanded	Quantity of labor supplied	State of the labor market
\$20	9,000	3,000	Shortage / Equilibrium / Surplus
\$30	8,000	4,000	Shortage / Equilibrium / Surplus
\$40	7,000	5,000	Shortage / Equilibrium / Surplus
\$50	6,000	6,000	Shortage / Equilibrium / Surplus
\$60	5,000	7,000	Shortage / Equilibrium / Surplus
\$70	4,000	8,000	Shortage / Equilibrium / Surplus
\$80	3,000	9,000	Shortage / Equilibrium / Surplus

4. In Figure 4-4.1, plot the market demand and supply curves for labor from Table 4-4.4. Label the demand curve as " $D_{\$2.00}$ " and the supply curve as "S".



Figure 4-4.1

The Labor Market



5. Why is the market demand curve for labor downward sloping? Why is the market supply curve of labor upward sloping?

Firms will hire more workers at a low wage and fewer workers at a high wage. The market demand is the sum of the individual demands of firms, and the MRP (demand) curve of a typical firm is downward sloping. Workers respond positively to a higher wage and will offer more labor as the wage increases. The market supply curve is the horizontal summation of the upward-sloping supply curves of individual workers.

6. Assume the wage is at some level greater than the equilibrium wage. Is there a shortage or surplus of labor? What adjustments take place in the market to move the wage to the equilibrium wage?
At a wage above the equilibrium wage, there will be a surplus of workers. This surplus puts downward pressure on the market wage. As the wage falls, the quantity demanded of workers increases and the quantity supplied decreases, until the surplus is eliminated.
7. Assume the wage is at some level less than the equilibrium wage. Is there a shortage or surplus of labor? What adjustments take place in the market to move the wage to the equilibrium wage?
At a wage below the equilibrium wage, there will be a shortage of workers. This shortage puts upward pressure on the market wage. As the wage rises, the quantity demanded of workers decreases and the quantity supplied increases, until the shortage is eliminated.
8. Assuming there are 1,000 firms identical to ABC in the belt industry, complete Table 4-4.5, based on the market price of belts being \$3.00.



Table 4-4.5

The Labor Market Based on the Price of Belts Being \$3.00

Wage	Quantity of labor demanded	Quantity of labor supplied*	State of the labor market
\$30	9,000	4,000	Shortage / Equilibrium / Surplus
\$45	8,000	4,500	Shortage / Equilibrium / Surplus
\$60	7,000	7,000	Shortage / Equilibrium / Surplus
\$75	6,000	8,000	Shortage / Equilibrium / Surplus
\$90	5,000	10,000	Shortage / Equilibrium / Surplus
\$105	4,000	11,500	Shortage / Equilibrium / Surplus
\$120	3,000	13,000	Shortage / Equilibrium / Surplus

*Some of the quantity supplied figures are interpolated from the supply data in Table 4-4.4.

9. In Figure 4-4.1, plot the market demand curve for labor from Table 4-4.5. Label the demand curve as “D_{\$3.00}.” (The supply curve is the same as in Table 4-4.4.)
10. Why did the market demand curve for labor shift to the right when the price of belts increased from \$2.00 to \$3.00?
The increase in price made the output of workers more valuable, thus increasing their MRP, which is the firms’ demand for labor.

11. What happened to the equilibrium wage and the equilibrium quantity of labor when the labor demand curve shifted to the right?
They both increased.

Part C: The Perfectly Competitive Labor Market and a Firm's Demand for Labor

A perfectly competitive employer takes the market wage and can hire all the labor it wants at that wage. The firm does not have to raise its wage to attract more workers. The labor supply curve for the firm is horizontal at the market wage. This supply curve is perfectly elastic. If the firm drops its wage below the equilibrium wage, it will not be able to hire any workers.



Figure 4-4.2

The Labor Market and a Typical Firm in That Market

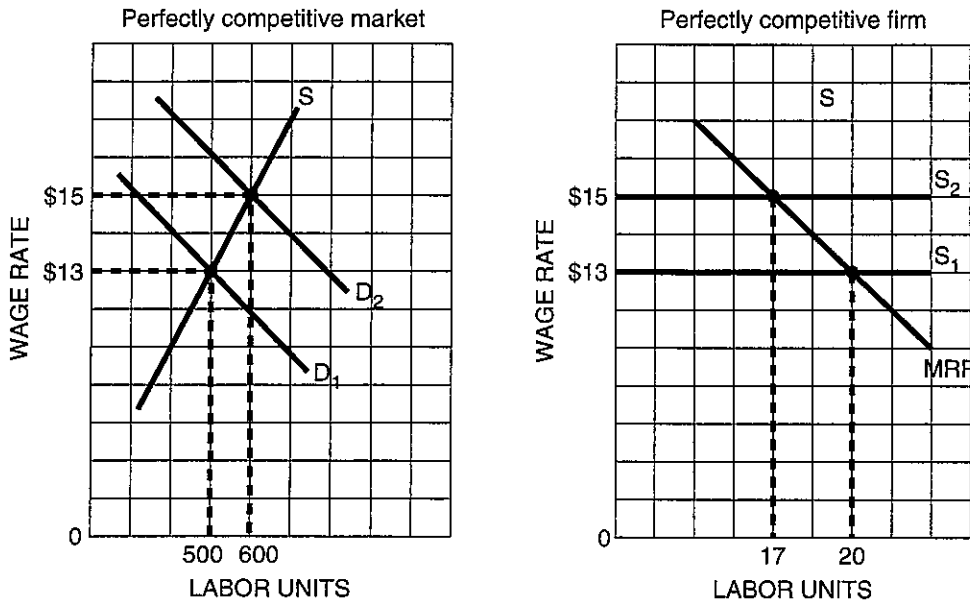


Figure 4-4.2 shows the competitive labor market and a typical firm that buys labor in that market. Answer the following questions based on this graph.

12. If the market demand for labor is D₁, the equilibrium wage will be \$ 13 and the equilibrium quantity of labor will be 500 workers.
13. How many workers will the firm hire at this market wage? 20 workers

14. If the market demand for labor increases to D_2 , the market wage will increase to \$ 15 and the equilibrium number of workers will increase to 600.
15. How many workers will the firm hire at this new market wage? 17 workers
16. When the market wage increased, did the firm hire more or fewer workers? Why?
It hired fewer workers. It dismissed three workers whose MRP made them worth a wage of \$13, but not worth a wage of \$15.
17. Is the firm's MRP curve also its demand curve for labor? Explain.
In this situation, the MRP curve is the firm's demand curve for labor. Because the firm hires labor in a perfectly competitive market, the wage is equal to the firm's marginal resource cost (MRC). Since the optimal amount of labor is found where $MRP = MCL$, the intersection of the horizontal labor supply curve and the firm's MRP curve tells you how many workers the firm should hire at each market wage.
18. Are the workers in this market demanded exclusively by firms that produce the identical good, or are they hired by firms that make a variety of different goods?
Typically, the workers are demanded by a variety of firms, not just by those in one particular industry.

How Wages Are Determined in Labor Markets

This activity examines how wages and employment are determined in two types of labor markets. A *perfectly competitive labor market* is one in which all buyers and sellers are so small that no one can act alone and affect the market wage. The interaction of market demand (D) and supply (S) determines the wage and the level of employment. A *monopsony* exists if there is only one buyer of labor in the resource market. The monopsonist pays as low a wage as possible to attract the number of workers needed.

Student Alert: If the monopsonist needs more workers, the wage will have to be raised.

Part A: A Perfectly Competitive Labor Market



Figure 4-5.1

A Perfectly Competitive Labor Market

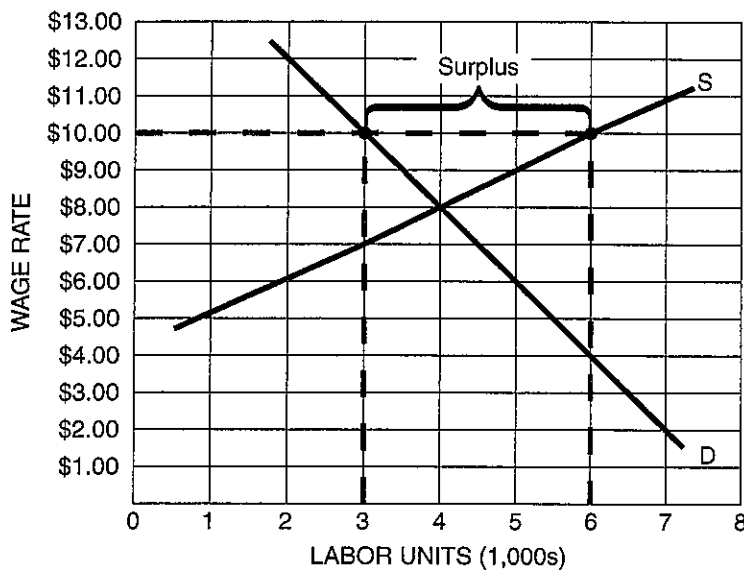


Figure 4-5.1 illustrates a perfectly competitive labor market. Labor is measured in thousands of labor hours. Answer the following questions based on this graph.

1. What are the equilibrium wage and number of labor hours in this labor market?
\$8.00 and 4,000 hours of labor
2. Why is the demand for labor downward sloping?
Firms will hire more workers if the wage is reduced.

3. Why is the supply of labor upward sloping?
Workers will offer more hours of labor at a high wage than at a low wage.

Part B: A Minimum Wage

4. Why does the government create a minimum wage in a labor market?
It does so to help low-income workers earn a higher income.
5. If the government sets a minimum wage of \$10.00 in the labor market shown in Figure 4-5.1, will there be a shortage or surplus of labor? How large is this shortage or surplus? Indicate this on the graph at the wage of \$10.00.
There will be a surplus of 3,000 labor hours. At this wage, the quantity supplied is 6,000 labor hours and the quantity demanded is 3,000 labor hours.
6. Are some workers made better off because of the minimum wage? Are some workers made worse off because of it? Explain.
Those workers who keep a job are better off because they receive a higher wage. Those workers who are fired are worse off because a wage of \$8.00 is better than no wage at all.
7. Would skilled or unskilled workers be more likely to lose their jobs because of a minimum wage law?
Unskilled workers would be more likely to lose their jobs because their MRP is lower than that of skilled workers.
8. If the demand for labor were more inelastic, would more or fewer workers lose their jobs because of the minimum wage? Explain.
If demand were more inelastic, employers would not have so strong a tendency to reduce their quantity demanded of labor when the wage increases. Thus, fewer workers would lose their jobs as a result of the minimum wage.

Part C: A Monopsonistic Labor Market

Assume the Ross Textile Company is a monopsony in a small town. Because it faces the upward sloping market supply of labor, Ross must raise its wage if it wants to increase the quantity supplied of workers. The company pays the same wage to all its employees, so if it increases the wage to attract another worker, the marginal resource cost of that worker is greater than the wage paid to the worker: $MRC > Wage$.

Student Alert: If the wage is raised to hire another worker, then $MRC > Wage$.

9. Table 4-5.1 shows the supply of labor to Ross. Complete the table.



Table 4-5.1

Labor Supply Schedule

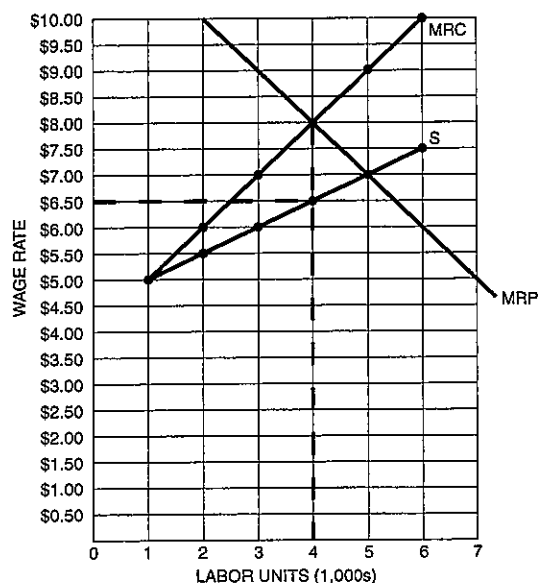
Workers	Wage	Total labor cost	Marginal resource cost
1	\$5.00	\$5.00	\$5.00
2	\$5.50	\$11.00	\$6.00
3	\$6.00	\$18.00	\$7.00
4	\$6.50	\$26.00	\$8.00
5	\$7.00	\$35.00	\$9.00
6	\$7.50	\$45.00	\$10.00

10. Plot the Ross Company's labor supply (S) curve and MRC curve in Figure 4-5.2. The firm's marginal revenue product (MRP) curve is already in the graph.



Figure 4-5.2

A Monopsonistic Labor Market



11. Why is the MRC curve above the S curve?
Because the firm pays all workers the same wage, when it increases its wage to attract another worker then the true cost to the firm of that worker is greater than the wage paid to that worker. The worker's MRC is his or her wage plus the increase in wages for all other workers.
12. What is more important to Ross as it considers hiring another worker—the wage paid to the worker or the worker's MRC? Why?
The MRC is more important. The firm hires the number of workers where $MRP = MRC$, not where $MRP = \text{Wage}$, because it is a monopsonist and not a perfectly competitive employer. The extra cost of an additional worker is the worker's MRC, not the worker's wage.
13. How many workers will Ross hire? What wage will it pay to each of these workers?
The firm will hire 4,000 workers because that is where $MRP = MRC$. It goes to the labor supply curve to find the wage needed to attract 4,000 workers: \$6.50.
14. Is the MRP curve the firm's D curve for labor?
No. Because the firm is a monopsonist, the wage is not equal to the MRC. The firm finds its profit-maximizing amount of labor where $MRP = MRC$, but it does not get the wage from the intersection of the MRP and MRC curves; it must go to the labor supply curve for the wage. A monopsonist in the resource market does not have a labor demand curve, similar to the way a monopsonist in the product market does not have a supply curve.
15. What would be the equilibrium wage and employment if this were a perfectly competitive market? How do these values compare with those of the monopsonist?
In a perfectly competitive market, equilibrium would be where the MRP curve intersects the S curve. The wage would be \$7.00 and the employment would be 5,000 workers. The wage and employment would be higher than in the case of monopsony.
16. If any firm hires the amount of labor at which $MRP = MRC$, is it also true that the firm is producing the output level at which $MR = MC$? Does the answer depend on whether the firm is perfectly competitive or monopolistic in the goods market, or whether it is perfectly competitive or monopsonistic in the labor market?
Hiring the amount of labor at which $MRP = MCL$ is the rule a firm follows to maximize its total profit. Thus, it must mean the firm is producing the profit-maximizing quantity of its product, which is found by producing where $MR = MC$. The degree of competition in the product and resource market does not change these two profit-maximizing rules.

Wages and Employment in Competitive and Monopsonistic Labor Markets

This activity asks you to show how changes in economic conditions, government policy, and union activity affect different types of labor markets. The impact of such changes depends on the degree of competition on the demand and supply sides of the labor market. The symbols W_C , L_C , W_M , and L_M refer to the wages and labor in the competitive and monopsonistic labor markets. You are to consider the short-run effects in the specified labor market.

Part A: Perfect Competition and Monopsony



Figure 4-6.1

Perfectly Competitive and Monopsonistic Labor Markets

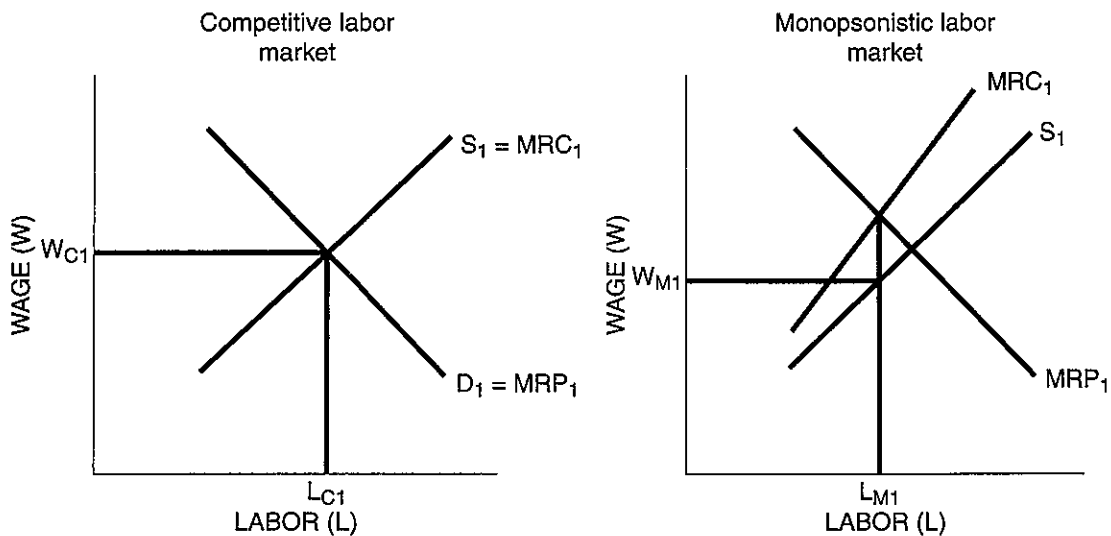


Figure 4-6.1 presents the basic setup of a perfectly competitive labor market and a monopsonistic labor market. Answer the following questions based on this figure.

1. Why is the marginal revenue product (MRP) curve equal to the market demand (D) curve for labor in the perfectly competitive labor market?

Because the firm hires labor in a perfectly competitive labor market, the wage it pays each worker is equal to the marginal resource cost of a worker. This means that by going to the marginal revenue product curve at each wage, the firm determines the number of workers to hire. This means the MRP curve is the firm's demand curve for labor.

2. Why is the MRP curve not equal to the market D curve for labor in the monopsonistic labor market?

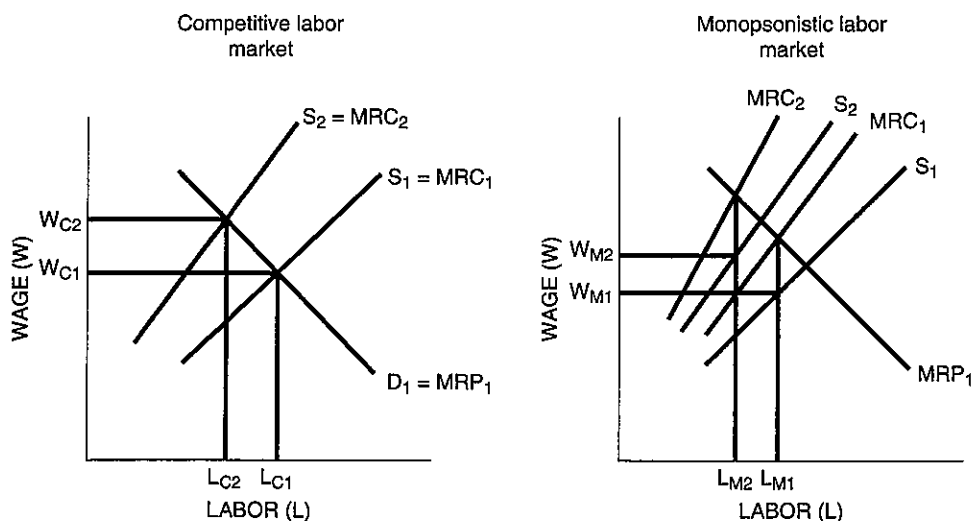
A monopsonist does not have a labor demand curve because there is no one curve the firm can go to at a given wage to find its optimal number of workers. It uses the MRP and MRC curves to determine the number of workers, then uses the labor supply curve to find the wage.

3. Why is the marginal resource cost (MRC) curve equal to the market labor supply (S) curve in the perfectly competitive labor market?
In a perfectly competitive labor market, the market wage is the firm's MRC of an extra worker. The firm can hire all the workers it wants at the market wage and does not have to increase the wage to attract another worker.
4. Why is the MRC curve not equal to the market labor S curve in the monopsonistic labor market?
The monopolist must increase its wage to attract another worker. Since it pays this higher wage to all workers, the MRC of an extra worker exceeds the wage paid to that worker.
5. In the appropriate graph, indicate by W_{C1} and L_{C1} , or W_{M1} and L_{M1} , the market wage and quantity of labor.

Part B: Analyzing Changes in the Labor Market

For each of the following scenarios, analyze the short-run effect of the specified event on each labor market. In the perfectly competitive labor market graph, indicate by W_{C1} and W_{C2} the market wage before and after the event. Indicate by L_{C1} and L_{C2} the equilibrium quantity of labor before and after the event. In the monopsonistic labor market graph, indicate by W_{M1} and W_{M2} the market wage before and after the event. Indicate by L_{M1} and L_{M2} the equilibrium quantity of labor before and after the event. State whether the event increases, decreases, or does not change the market wage and labor. Be sure to shift the curves that are affected by the events, leading to the changes in wage and labor.

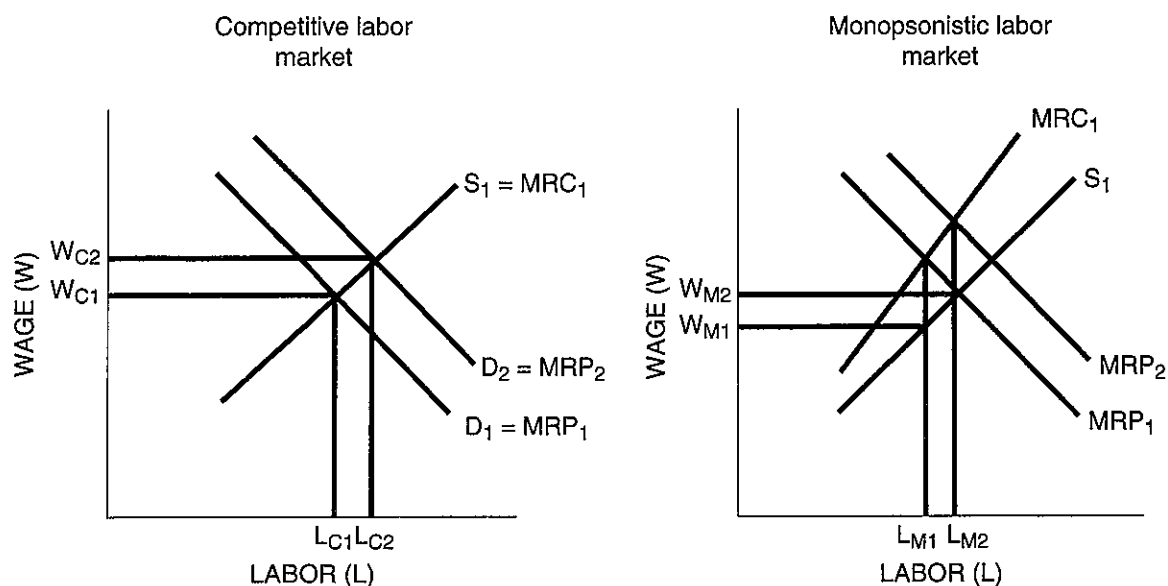
6. Event: The state passes legislation requiring new teachers to pass a competency test in order to be employed by any school in the state. (The graphs refer to the labor market for teachers.)



Competitive labor market: wage increases, labor decreases

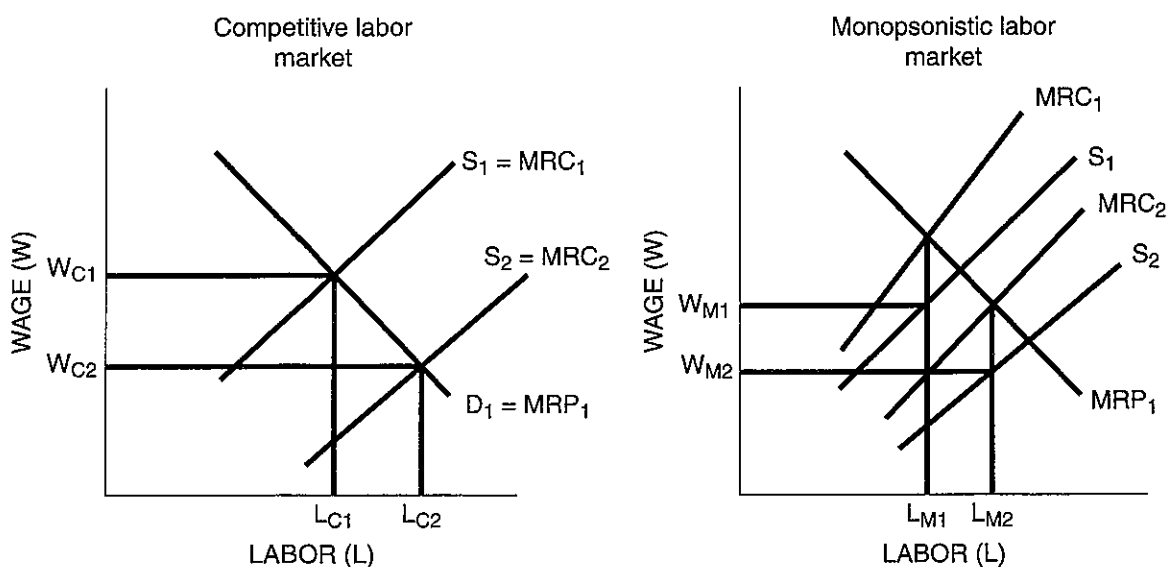
Monopsonistic labor market: wage increases, labor decreases

7. Event: New training methods increase the productivity of workers in the automobile industry.
(The graphs refer to the labor market for automobile workers.)



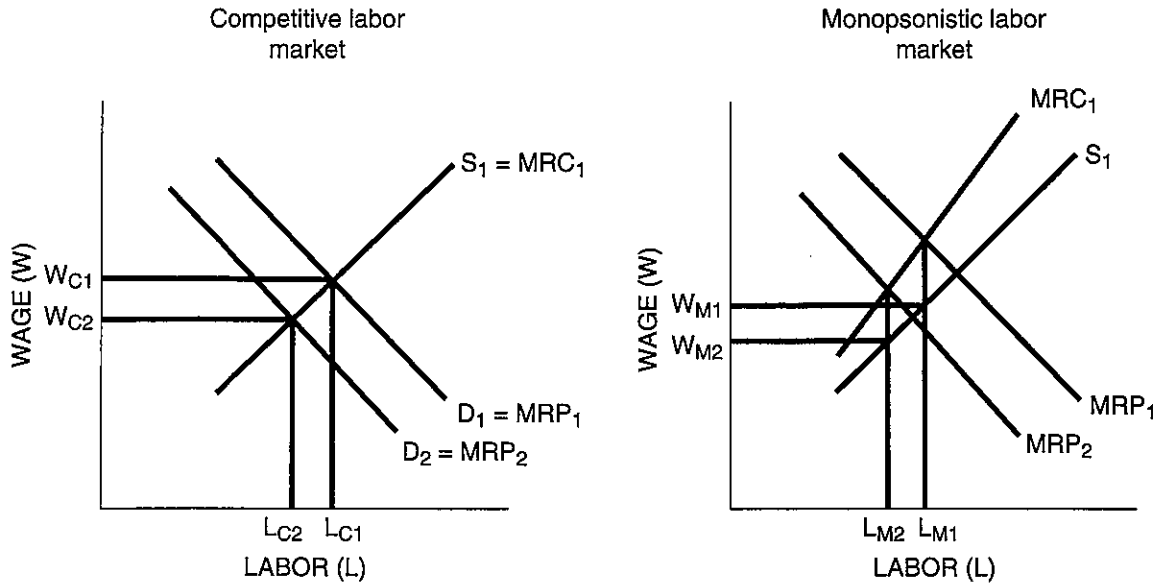
Competitive labor market: wage increases, labor increases
Monopsonistic labor market: wage increases, labor increases

8. Event: The U.S. government relaxes a tough immigration law, making it easier for construction workers from other countries to enter the United States. (The graphs refer to the American labor market for construction workers.)



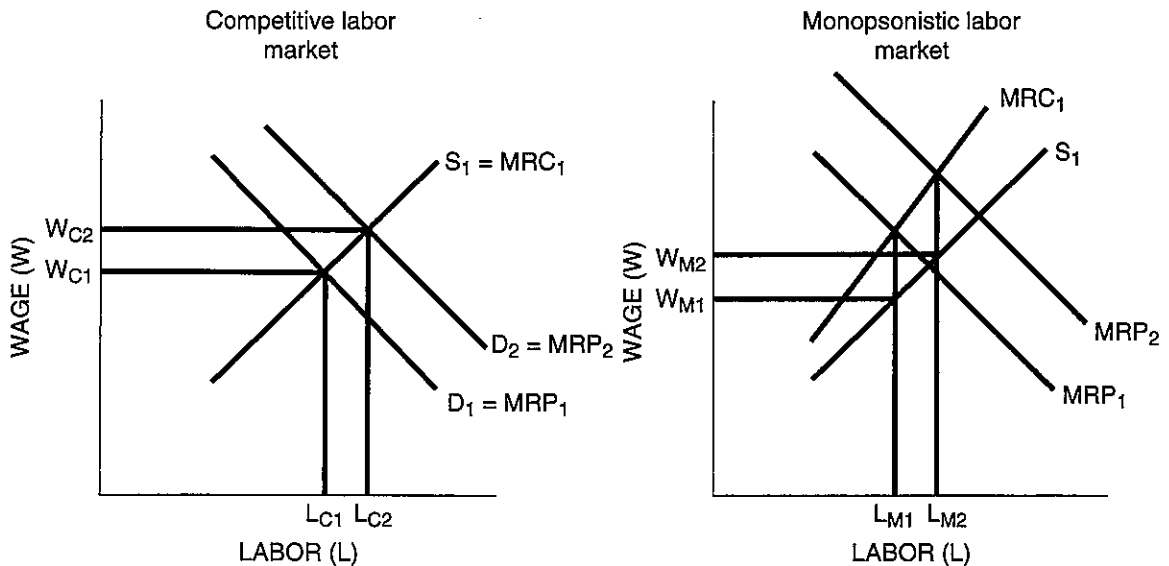
Competitive labor market: wage decreases, labor increases
Monopsonistic labor market: wage decreases, labor increases

9. Event: The German government lowers tariffs on shoes imported into Germany. (The graphs refer to the labor market for shoe workers in Germany.)



Competitive labor market: wage decreases, labor decreases
Monopsonistic labor market: wage decreases, labor decreases

10. Event: Labor unions conduct a successful advertising campaign urging people to buy goods and services produced by American workers. (The graphs refer to the labor market for all American workers.)



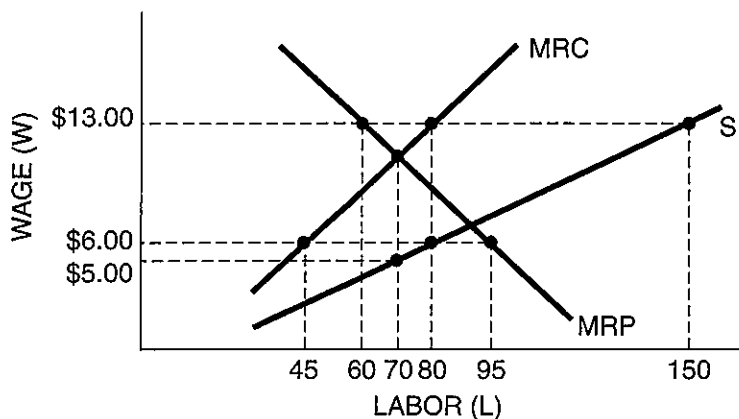
Competitive labor market: wage increases, labor increases
Monopsonistic labor market: wage increases, labor increases

Part B: Monopsony and a Minimum Wage

Figure 4-6.2 illustrates the labor market in which there is only one employer. This monopsonist sells its good in a perfectly competitive product market.



Figure 4-6.2

A Monopsonistic Labor Market

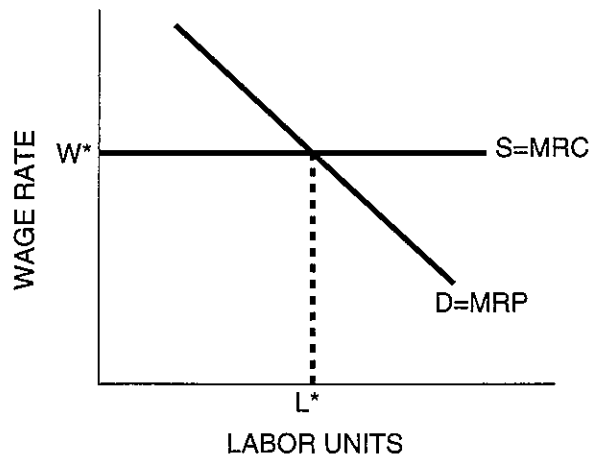
1. What is the profit-maximizing amount of labor for this monopsonistic firm? Why?
The firm will hire 70 units of labor because that is where $MRP = MRC$.
2. What wage will it pay each unit of labor? Why?
It will pay a wage of \$5.00, as shown on the S curve at 75 units of labor.
3. If the government sets a minimum wage of \$13.00, how many units of labor would be hired? How many units of labor will be unemployed with this minimum wage? Explain.
At a minimum wage of \$13.00, 60 units of labor will be hired where the MRP curve intersects the revised MRC curve. The MRC of labor will be shown as a horizontal line at \$13.00 out to the labor supply curve at 150 units because the firm can attract up to 150 labor units at a wage of \$13.00. To attract more than 150 labor units, the firm will have to offer a wage higher than \$13.00. The cost of an extra unit of labor jumps up to the original MRC curve beyond 150 labor units. At the high minimum wage of \$13.00, 150 labor units are supplied but only 60 are hired. The result is unemployment of 90 labor units.
4. If the government sets a minimum wage of \$6.00, how many units of labor would be hired? How many units of labor will be unemployed with this minimum wage? Explain.
At a minimum wage of \$6.00, 80 units of labor will be hired where the MRP curve intersects the revised MRC curve. The MRC of labor will be shown as a horizontal line at \$6.00 out to the labor supply curve at 80 units because the firm can attract up to 80 labor units at a wage of \$6.00. To attract more than 80 labor units, the firm will have to offer a wage higher than \$6.00. The cost of an extra unit of labor jumps up to the original MRC curve beyond 80 labor units. At the minimum wage of \$6.00, 80 labor units are supplied and all 80 units are hired. The result is zero unemployment at a minimum wage of \$6.00.

Problems Dealing with Factor Markets

Part A: Factor Market Questions

Answer the questions and briefly explain your answers. Feel free to use diagrams to illustrate your points.

- Why are some basketball players paid more than brain surgeons? Explain using the concept of marginal revenue product.
Because there is such a high demand of fans to watch star basketball players, their MRPs are very high. There are few close substitutes for a great basketball player. As teams compete for the best players, the star players receive salaries approximately equal to their high MRPs. Brain surgeons perform a valuable service and receive high salaries, but the number of brain surgeons compared to the demand for them means some star basketball players receive relatively higher salaries.
- True, false, or uncertain, and explain why? “If it were not for unions pushing up wages, we’d all be working 60 hours a week for \$100 a month just like people did a century ago.”
False. Although unions may raise the wages of their members, the biggest factor in increasing real wages is higher productivity. Increases in real wages depend on increases in real output. Unions may have been responsible for social legislation, but increasing MRP is more important.
- Use a graph to explain why a firm that wants to maximize its total profits uses a resource until the marginal revenue product of this resource equals the marginal resource cost.



This graph shows a firm that hires labor in a perfectly competitive resource market. By hiring L^ labor units, the firm hires all the labor units with $MRP > MRC$. These are the units that generate positive marginal profit for the firm. By stopping at L^* units, the firm does not hire labor units with $MRP < MRC$, units that would decrease the firm's total profit.*

- True, false, or uncertain, and why? “American workers who are paid \$10 an hour cannot possibly compete with workers who are paid \$1 an hour in developing countries.”
False. American workers tend to be paid more because their productivity is high. Increases in real wages depend on increases in real output.

5. Why might a university pay a Nobel Prize-winning faculty member more than its president? Does this make sense economically for the university? Support your answer.
The Nobel Prize winner increases the reputation of the university and attracts more students, thus increasing the university's total revenue. Because the MRP of the professor is greater than the MRP of the president, the salary of the professor could be greater than the salary of the president.
6. What are the effects of a minimum wage that is above the equilibrium wage in a perfectly competitive market? What about in a market in which the employer is a monopsonist? Give an example of a relatively competitive labor market and a less competitive labor market.
In a competitive labor market, a minimum wage above the equilibrium wage increases the number of workers who want to work (quantity supplied) and decreases the number of workers firms want to hire (quantity demanded). The result is a surplus of workers at the minimum wage: unemployment. For a monopsonist, the MRC curve is located above the labor supply curve. This results in a lower wage and lower employment than in a perfectly competitive labor market. Raising the minimum wage in a monopsonistic labor market will increase employment and wages as long as the minimum wage is less than the wage where $MRP = MRC$. Most economists believe that labor markets are closer to perfect competition than to monopsony. There are numerous examples of competitive labor markets, such as the market for accountants in a large metropolitan area. Examples of monopsonistic labor markets would be a specialized company in a small town or a supplier to a rural military base.
7. The National Collegiate Athletic Association (NCAA) regulates all college athletics in the United States. It sets the amount of scholarships, the number of scholarships granted, and the regulations for recruiting athletes. The NCAA has hundreds of rules regulating intercollegiate athletics.
- (A) What effect do these regulations have on who receives the economic rent from college athletics?
They set the level of the athletes' benefits and salaries so the universities receive the economic rent.
- (B) Which colleges have greater incentives to cheat? Why?
Colleges with increased incentives to violate NCAA rules could include those that do not have national academic prestige and cannot recruit against the colleges that do. Colleges with big arenas and stadiums that they need to fill also can be tempted to break rules to sign a star athlete who can boost the school's reputation and revenue.
- (C) Who would gain if the NCAA could no longer set rules for college athletics? Why?
Top athletes at major universities would receive substantial salaries rather than standard scholarships. Players in major revenue sports would benefit, while players in low-revenue sports will be hurt.
- (D) Who would lose if the NCAA could no longer control college athletics? Why?
Universities would see their expenses increase as they would have to compete with other institutions for the best athletes.
- (E) True, false, or uncertain, and why? "The NCAA is a champion for amateur athletics, and its rules protect the rights of college athletes."
False or uncertain. The NCAA does champion the cause of amateur athletics, but this may benefit the universities more than the athletes. A case can be made that the NCAA is a champion for the majority of amateur athletes who are not in the major revenue sports. In the absence of the NCAA, athletes who are less successful would not be able to participate.

Part B: How Many Workers to Hire?

Table 4-7.1 gives you information about a firm operating in a perfectly competitive product market. Consider all factors of production fixed, with the exception of labor. The other factors of production cost the firm \$50 a day, which may be thought of as the firm's total fixed cost. Assume the firm is a profit maximizer.



Table 4-7.1
Firm Operating in a Competitive Product Market

Labor (L) (workers per day)	Output (Q) (units per day)	Marginal physical product (MPP)	Total revenue (TR)	Marginal revenue product (MRP)
0	0	–	\$0	–
1	22	+22	\$66	+\$66
2	40	+18	\$120	+\$54
3	56	+16	\$168	+\$48
4	70	+14	\$210	+\$42
5	82	+12	\$246	+\$36
6	92	+10	\$276	+\$30
7	100	+8	\$300	+\$24
8	106	+6	\$318	+\$18

Fill in the answer blanks or underline the correct words in parentheses.

8. Assume the firm sells its output at \$3 per unit. Complete Table 4-7.1.

(A) If the equilibrium market wage is \$36 per day, the firm will hire 5 workers per day and produce 82 units of output.

(B) Given your answer to the preceding question, the firm will have total revenue of \$246 per day and total cost of \$230 per day.
Total cost = (5 workers)(\$36) + \$50 = \$230.

(C) The above will result in a (profit / loss) of \$16 per day.

9. Suppose you work for a firm that sells its output in a monopolistic market. Answer the following questions.

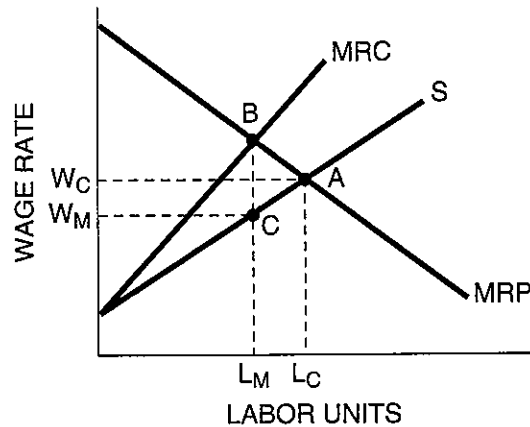
(A) If you hire an additional worker, output goes up from 75 to 125 units per day. If you want to sell the additional 50 units, you must lower your price from \$3 per unit to \$2 per unit. What is the highest wage you would be willing to pay the additional worker?

The highest wage you would be willing to pay is equal to the worker's MRP. The total revenue from 75 units is $(75)(\$3) = \225 . The total revenue from 125 units is $(125)(\$2) = \250 . The MRP of the extra worker is $+\$25$, so this is the highest wage you would pay.

(B) Assume that you hired the additional worker and output now stands at 125 units per day. If you hire another worker, output rises to 165 units per day. Given the demand curve for your product, you know that to sell the additional output, price will have to be dropped from \$2 per unit to \$1 per unit. What is the maximum wage you would be willing to pay *this* additional worker? Would you hire this additional worker? Why or why not?

The total revenue from 125 units is \$250. The total revenue from 165 units is $(165)(\$1) = \165 . The MRP of this extra worker is $-\$85$. There is no wage at which you would find this worker profitable because MRP is negative.

10. Use a graph to explain why monopsonists will always hire fewer workers and pay lower wages than firms operating in competitive labor markets. (Assume that the monopsonistic and competitive firms have the same costs.)



If this were a monopsonistic labor market, the optimal quantity of labor would be L_M because that is where the MRP curve intersects the MRC curve at point B. The monopsony wage would be W_M , found on the labor supply curve at point C for quantity L_M . L_M is the optimal number of labor units for a monopsony because to the left of point B, $MRP > MRC$, and to the right of point B, $MRP < MRC$. In a perfectly competitive labor market, the MRP curve would represent the demand for labor curve and the S curve would represent the MRC curve. Equilibrium would be at point A where the S curve intersects the MRP curve, with labor quantity L_C and wage W_C . For labor units to the left of point A, $MRP > MRC$, and for units to the right of point A, $MRP < MRC$. The labor quantity is smaller in the monopsonistic labor market than in the perfectly competitive labor market because the MRC of labor is greater in the monopsonistic market. The wage is lower in the monopsonistic labor market because the wage the monopsony must pay for only L_M units is less than the wage needed to attract L_C units.