Chapter 3
The Demand for Labor

Summary

The demand and supply model of the labor market presented in Chapter 2 provides an effective framework for thinking about a wide variety of labor issues. To properly use that framework when analyzing policy issues, however, one must fully understand each component of the model. In this chapter, the focus is on the demand side of the model. The demand for labor is called a derived demand, because it comes from the demand for the products that workers produce.

The key to understanding where an individual firm’s demand curve for labor comes from is to realize that every point on the demand curve is the result of an optimization decision by the firm. At a given wage rate, the quantity that is read off the demand curve represents the profit-maximizing level of employment for that wage rate.

As the firm hires more workers, total output will increase. But the marginal product of labor ($MP_L$), the amount of additional output associated with an additional unit of labor, is assumed to eventually decrease. Holding the stock of capital constant, hiring one more worker may initially result in an increase in the marginal, due to gains from specialization or cooperation. However, at some point, hiring one more worker will eventually result in a lower marginal product than that of the previous worker. This occurs because with a fixed stock of capital, capital will become scarce relative to the number of workers, and thus the productivity of each additional worker will be less, diminishing marginal returns.

In the short run, with the firm’s capital stock fixed, there is one guiding principle behind the profit-maximization strategy. The firm will maximize profits when the marginal (extra) revenue associated with hiring an additional unit of labor ($MR_L$) just equals the marginal expense of hiring an additional unit of labor ($ME_L$). If this condition is not met, a window of opportunity exists for the firm to change its employment level and increase its profits. The marginal revenue associated with an additional unit of labor is called the marginal revenue product of labor ($MRPL$) since it can be shown that it is equal to ($MR$) $\times$ ($MP_L$). $MR$ is the marginal revenue associated with the sale of an additional unit of output, and $MP_L$ is the marginal product (physical output) associated with an additional unit of labor ($\Delta Q/\Delta L$).

The details of the profit-maximization exercise, however, are also influenced by the firm’s position in both the input and output markets. Is the firm the sole buyer of labor (a monopsony, discussed in Chapter 5) or just one small buyer among many (a competitor in the input market)? Is the firm the only seller of its product (a monopoly), or does it face such vigorous competition that is essentially a price taking firm (a competitor in the output market)? These are the key questions that must be answered before the exact nature of the short-run profit-maximization exercise can be described.

When the firm faces competition in the output market, $MR$ will simply be the price of the product ($P$). Similarly, when the firm faces competition in the input market, $ME_L$ will equal the wage rate ($W$). The various possibilities for expressing the short-run profit-maximization condition in a competitive labor market are summarized in Table 3-1.
### Table 3-1

<table>
<thead>
<tr>
<th>Output Market Structure</th>
<th>Maximization Condition</th>
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</thead>
<tbody>
<tr>
<td>Competition</td>
<td>( P \times MP_L = W )</td>
</tr>
<tr>
<td>Monopoly</td>
<td>( MR \times MP_L = W )</td>
</tr>
</tbody>
</table>

To see how these short-run profit-maximization conditions lead to the firm’s demand curve for labor, suppose the firm has a fixed capital stock of 10 units and a production function given by the equation

\[
Q = KL - 0.0125KL^2,
\]

where \( K \) stands for units of capital. Then in the short run the production function can be written as

\[
Q = 10L - 0.125L^2.
\]

For this production function, the marginal product of labor is always declining and given by the equation \( MP_L = 10 - 0.25L \). (For the reader with calculus training, the marginal product of labor can be computed by taking the first derivative of the short-run production function.) Also assume the firm takes prices as given in both input and output markets, selling its product at a price of $2, and hiring labor at the going wage rate of $10.

Given the assumption of competition in the output market, marginal revenue equals the market price, so the marginal revenue product (\( MRPL \)) equals \( P \times MP_L = 20 - 0.5L \). Given the assumption of competition in the input market, the marginal expense of labor \( ME_L \) equals the wage of $10. Solving for \( L \), \( MRPL = 20 - 0.5L = ME_L \), which yields \( L = 20 \). At any (*) level of employment less than 20, the \( MRPL \) exceeds the \( ME_L \) and the firm can increase its profits by increasing the quantity of labor it uses. Alternatively, at values of \( L \) greater than 20, the \( MRPL \) is less than the \( ME_L \), signifying that the firm hired some workers who added less in revenue than they added in costs. By reducing employment, the firm could increase its profits. Only at \( L = 20 \) has the firm made all the profit-increasing hires and none that reduce profits. Therefore, the coordinates \( W = $10, L = 20 \) denoted by point a in Figure 3-1 represent a point on the firm’s short-run demand curve for labor.

(*) Readers should note that profits would not rise when increasing employment from 19 to 20 in this example, since by construction, the 20th unit of labor adds exactly as much to revenues as to costs. However, note that the 19th worker adds $.50 to profits, just as a 21st worker would reduce profits by $.50. Employing labor, or any input to the point where \( MRP = ME \), or, if they cannot be precisely equated, to the point where the next unit’s \( MRP \) would be less than its \( ME \), assures that all possible profits have been extracted, although when \( MRP \) exactly equals \( ME \), the last unit employed has no impact on profits.

![Figure 3-1](image-url)
As the wage changes, the firm simply moves up or down along the $MRP_L$ curve, tracing out the entire short-run demand curve, the curve that by definition represents what the firm wishes to hire at any given wage rate. The curve can also be depicted as the quantity of labor associated with any given value of the real wage ($W/P$). In this case, the marginal product schedule becomes the firm’s labor demand curve. Note that changes in the original specification of the production function (i.e., the firm’s technology), the level of capital, or the price of the final product (through, say, a shift in the demand for the product) would all change the position of the $MRP_L$ curve.

Once the firm’s labor demand curve is identified, the **market demand** curve can be constructed by summing horizontally all the individual firm demand curves (i.e., adding the quantities of labor demand by each firm at a given wage rate, and then repeating for all wage rates), provided the individual firm demand curves are expressed in terms of the real wage.

The long-run demand for labor is also generated through a profit maximization exercise. Assuming competitive input markets with a given wage and price of capital, the key is to find the **cost-minimizing combination** of labor and capital associated with the firm’s optimal output. The cost-minimizing combination occurs when

$$\frac{W}{MP_L} = \frac{C}{MP_K},$$

where $C$ refers to price of capital, and $MP_K$ refers to the marginal product of capital. The ratio of an input’s price to its marginal product gives the marginal cost of producing output using that input. If this equality did not hold, there would be a window of opportunity to produce the same output level at lower cost by using a different input mix.

What is the optimal output for the firm to produce? This occurs where the marginal revenue ($MR$) just equals the marginal cost ($MC$). Here the $MC$ refers to the change in total cost (expense) associated with an additional unit of output. In the short run, as the wage changes, the firm facing competition in the input markets simply moves along its $MRP_L$ curve. In the long run, however, a rise in the wage typically brings about a substitution of capital for labor and vice versa. In addition to this **substitution effect**, an increase (decrease) in the wage increases (decreases) the marginal cost of production, leading to a decrease (increase) in output. The change in output causes the firm to change the quantity of labor and capital it demands in the same direction. This change is called the **scale effect**.

**Example**

Consider a firm with a production function given by the equation

$$Q = \sqrt{L}\sqrt{K}.$$

This equation is an example of a Cobb-Douglas production function. For a firm facing competition in the input markets, it can be shown (using the cost-minimizing conditions mentioned earlier along with the production function) that for any given level of output the cost minimizing levels of $L$ and $K$ are given by the equations

$$L^* = \frac{\sqrt{C}}{\sqrt{W}} Q, \quad K^* = \frac{\sqrt{W}}{\sqrt{C}} Q.$$

If $W = 4$ and $C = 16$, for example, then $L^* = 2Q$ and $K^* = .5Q$. But what is the optimal level of $Q$?
Recall that the firm finds its optimal output where \( MR = MC \). If the firm is a monopolist in the output market and faces a demand curve given by the equation \( P = 36 - Q \), then its marginal revenue will be \( MR = 36 - 2Q \). But what is its marginal cost? The firm’s total cost (\( TC \)) can always be expressed as \( TC = WL + CK \). Substituting the expressions for the optimal levels of \( L \) and \( K \) yields

\[
\begin{align*}
TC &= W \frac{\sqrt{C}}{\sqrt{W}} Q + C \frac{\sqrt{W}}{\sqrt{C}} Q, \\
&\Rightarrow TC = 2\sqrt{W \sqrt{C}} Q.
\end{align*}
\]

Since every time \( Q \) changes by one, \( TC \) changes by \( 2 \), \( WC \) and the expression for marginal cost must be

\[
MC = 2\sqrt{W \sqrt{C}}.
\]

Assuming \( W = $4 \) and \( C = $16 \), \( MC = $16 \). Setting \( MC = MR (= 36 - 2Q) \) implies that the optimal level of output is \( Q = 10 \). Substituting this value back into the simplified \( L^* \) and \( K^* \) expressions yields \( L = 20 \) and \( K^* = 5 \). The total cost associated with this input use would be \( 4(20) + 16(5) \) for a total of \( $160 \).

Now suppose the wage rises from \( $4 \) to \( $9 \), what would be the effect on the quantity of labor demanded in the long run? With the new wage rate, notice that the optimal expressions for \( L \) and \( K \) become \( L^* = (4/3)Q \) and \( K^* = (3/4)Q \). If \( Q \) were to remain at 10, then the firm would change its input mix to \( L^* = 13.33 \) and \( K^* = 7.5 \). This reduction in \( L \) from 20 to 13.33 and the increase in \( K \) from 5 to 7.5 is called the substitution effect of the wage increase. It occurs because labor is more expensive relative to capital than it was originally, so the firm economizes on labor to limit the amount of the cost increase it faces. Notice that after the firm substitutes capital for labor, costs rise from \( $160 \) to \( TC = $9(13.33) + 16(7.5) = $240 \), reducing profits to \( $20 \). However, this rise is significantly less than if the firm had not changed its input mix at all. Staying with the original combination of inputs would have led to \( TC = $9(20) + 16(5) = $260 \) and eliminated profits.

The problem is that with the increase in the wage from \( $4 \) to \( $9 \), the optimal output of the firm will not stay at 10 units. Why? Substituting the new input price into the marginal cost expression, notice that \( MC \) has risen from \( $14 \) to \( $24 \). With this rise in the \( MC \), the optimal output falls to \( 36 - 2Q = 24 \), and \( Q^* = 6 \). Substituting this new output into the new \( L^* \) and \( K^* \) expressions yields \( L^* = (4/3)6 = 8 \), and \( K^* = (3/4)6 = 4.5 \).

The net result of \( W \) increasing from \( $4 \) to \( $9 \) was that \( L^* \) fell from 20 to 8 (a reduction of 12 units), and \( K^* \) fell from 5 to 4.5 units (a reduction of 0.5 units). This can be explained by a substitution effect where \( L \) fell from 20 to 13.33 (a reduction of 6.67) and a scale effect where \( L^* \) fell from 13.33 to 8 (an additional reduction of 5.33). Similarly, the reduction in \( K^* \) can be explained by a substitution effect where \( K^* \) increased from 5 to 7.5 (a 2.5-unit increase), but also a scale effect where \( K^* \) fell from 7.5 to 4 (a 3-unit decrease). Total costs are now \( $9(8) + 16(4.5) = 144 \). With output reduced to 6, price rises to \( 36 - 6 = $30 \), so total revenue is \( 30(6) = 180 \), and profits equal \( 180 - 144 = $36 \).

Notice that for labor (the input whose price changed) the substitution and scale effects reinforce one another, leading to a downward sloping demand curve. However, for capital (the other input), the substitution and scale effects counteract. In general, when the scale effect dominates the substitution effect (as it did in this example) so that \( L^* \) and \( K^* \) move together, labor and capital are called gross complements. On the other hand, it is possible for the substitution effect to dominate the scale effect, in which case \( L^* \) and \( K^* \) would move in opposite directions and be called gross substitutes. In the event that labor and capital are used in fixed proportions, there is no substitution effect and so labor and capital will be gross complements.
In actually applying this theory to the labor market, it is usually more interesting to look at what happens to labor when the price of the other input changes, but the same basic principles apply. In such situations, if labor and capital are gross complements, the firm’s long-run labor demand curve shifts to the left as the price of capital increases, and shifts right if they are gross substitutes. Also, the framework can be used to think about how different types of labor interact (e.g., full-time vs. part-time, teenagers vs. adults, union vs. non-union, men vs. women) when the wage of just one group changes.

When the firm has monopoly power in the product market, the details of the analysis are different. For a firm with monopoly power in the output market, the given information must include the market demand curve for the product the firm produces. Marginal revenue for a monopolist will always be less than the price of the last unit of output, because for a monopolist, selling more requires lowering the price of all units. (If the demand curve is linear, it could be written in the form \( P = a - bQ \), where \( a \) and \( b \) are constants greater than zero, and \( Q \) stands for quantity demanded. Marginal revenue is then given by the equation \( MR = a - 2bQ \). To find the marginal revenue product (\( MRP_L \)) expression, one substitutes the short-run production function for the variable \( Q \) in the marginal revenue expression and then multiplies the resulting expression by the marginal product.) Thus the \( MRP_L \) curve for a monopolist will lie below the \( MRP_L \) curve for an otherwise identical competitive firm. If it is assumed that both firms hire at a competitive wage rate, monopolists will hire fewer workers than equivalent competitive firms.

The rest of the chapter uses the concept of market demand to look at the question of who bears the burden of payroll taxes and whether differences in payroll tax rates across countries can explain differences in unemployment rates. The flip side of payroll taxes—wage subsidies—are also examined for their effectiveness in expanding employment and raising the incomes of low-wage workers. The analysis shows that a significant portion of payroll taxes can fall on workers, and this burden increases when the supply of labor is not particularly responsive to changes in the wage. Additionally, wage subsidies have not been found in practice to be very effective at raising the employment or wages of low-wage workers. A lack of employer awareness of the availability of subsidies and eligibility requirements for prospective employees both appear to diminish the potential effectiveness of wage subsidies.

The appendix to this chapter develops aspects of short-run and long-run demand graphically, using the tools of isoquants and isoexpenditure lines. Isoquants represent all the different combinations of labor and capital that can produce the same output level. The slope of the isoquant expressed positively is called the marginal rate of technical substitution (\( MRTS \)). Its magnitude can be found by taking the ratio of the marginal product of labor to the marginal product of capital at any combination of \( L \) and \( K \) along the isoquant. Isoquant maps reflect the assumption that short-run production functions will exhibit diminishing marginal productivity.

Isoexpenditure lines show all the combinations of \( L \) and \( K \) that cost the same. The magnitude of the slope of the isoexpenditure line is given by the ratio of the price of labor to the price of capital. The appendix clearly shows that cost minimization in the long run occurs when the firm reaches the lowest isoexpenditure line associated with a given isoquant. This typically occurs when the firm chooses values of \( L \) and \( K \) associated with a tangency between the two curves. Since tangency points equate slopes, this implies that the ratio of marginal products equals the ratio of input prices, which was earlier demonstrated to be a cost-minimizing condition. Finally, substitution and scale effects for an increase in the wage are shown graphically.
Review Questions

Choose the letter that represents the **BEST** response.

Assumptions of the Labor Demand Model

1. When a firm faces competition in the labor market
   a. the wage the firm pays can be treated as constant.
   b. the firm can buy as much or as little labor as it wants at a going wage rate.
   c. the firm’s marginal expense of labor equals the wage rate.
   d. all of the above.

2. When a firm faces competition in the product market
   a. the product price the firm receives can be treated as a given.
   b. the firm can sell as much or as little of its product as it wants at a going price.
   c. the firm’s marginal revenue equals the product price.
   d. all of the above.

3. As the firm increases its employment, it is typically assumed that the marginal product of labor will eventually decline. An economic reason for why this occurs is that
   a. the law of diminishing returns applies.
   b. an increase in employment causes the wage to fall and this, in turn, causes workers to exert less effort.
   c. at some point, additional units of labor bring about a smaller change in total output than previous units did.
   d. Each additional worker has a smaller share of capital with which to work.

Short-Run Demand for Labor

4. A firm will maximize its profits in the short run when
   a. the difference between \( MR_L \) and \( ME_L \) is as large as possible.
   b. \( MR_L \) equals \( ME_L \), or the difference between them is as small as possible.
   c. the money wage workers receive \( W \) equals the marginal product.
   d. the marginal revenue product \( (MRP_L) \) equals the marginal cost \( (MC) \).

5. The marginal revenue product curve is the firm’s short-run demand curve for labor provided
   a. the firm faces competition in the labor market.
   b. the firm faces competition in the output market.
   c. \( MRP_L = MR \times MP_L \).
   d. both a and b.
6. For a firm to survive in a competitive environment
   a. it must follow the \( MRP_L = ME_L \) rule.
   b. it must act as if it is following the \( MRP_L = ME_L \) rule.
   c. it must be able to verbalize the conditions for profit maximization.
   d. it must be able to accurately measure the marginal revenue product of its workers.

7. Figure 3-2 shows the short-run labor demand curves (expressed as a function of the real wage) for the three individual firms that hire this type of labor. At a real wage of 10, the quantity associated with the market demand curve would be
   a. 15 units of labor.
   b. 17.5 units of labor.
   c. 20 units of labor.
   d. 35 units of labor.

8. Assume the price of labor \( (W) \) equals $10 and the price of capital \( (C) \) equals $36. Also suppose that at the current mix of labor and capital, \( MPL = 5 \) and \( MPK = 12 \). Using the rule for cost minimization, which of the following correctly describes what the firm should do to its labor and capital mix?
   a. Increase \( L \) and decrease \( K \).
   b. Decrease \( L \) and increase \( K \).
   c. Increase both \( L \) and \( K \).
   d. \( L \) and \( K \) should not change.

9. Suppose the price of capital falls. If the scale effect associated with the price change dominates the substitution effect,
   a. the quantity of labor demanded will increase.
   b. the quantity of labor demanded will decrease.
   c. labor and capital can be called gross substitutes.
   d. both b and c.
10. Suppose the price of capital falls. If capital and labor are used in fixed proportions in the production process,
   a. the substitution effect is zero.
   b. the scale effect will dominate the substitution effect.
   c. labor and capital will be gross complements.
   d. all of the above.

11. If the price of capital rises and the long-run demand for labor curve shifts right, one can infer that
   a. the scale effect dominated the substitution effect.
   b. the substitution effect dominated the scale effect.
   c. labor and capital are gross substitutes.
   d. both b and c.

Who Bears the Burden of the Payroll Tax?
In answering Questions 15–18, refer to Figure 3-3. The curve labeled \( D_0 \) represents the short-run market demand before the payroll tax is imposed, while \( D_1 \) represents the curve after a tax (in real terms) of \( X \) per employee has been imposed on the firm. The curve labeled \( S \) is the market supply curve for labor. The wage on the vertical axis represents the real wage \( (W/P) \) employees actually receive.

![Figure 3-3](image)

12. What is the amount of the tax?
   a. \( X = 0.5 \)
   b. \( X = 1 \)
   c. \( X = 2 \)
   d. \( X = 4 \)

13. The percentage of the tax the workers bear in the form of lower wages is
   a. 10%.
   b. 25%.
   c. 50%.
   d. 100%.
14. What has been the effect of the payroll tax on the employment level?
   a. Employment has fallen by 1.
   b. Employment has fallen by 2.
   c. Employment has risen by 1.
   d. There has been no change in employment.

15. What percentage of the tax would the worker bear in the form of lower wages if the supply curve ($S$) were perfectly vertical (i.e., quantity supplied was extremely insensitive to changes in the wage)?
   a. 0%
   b. 25%
   c. 50%
   d. 100%

A Graphical Approach to Labor Demand (Appendix 3A)

In answering Questions 19–21, refer to Figure 3-4, which shows the cost-minimizing combination of $L$ and $K$ for producing 100 units of output when $W = $16 and $C = $25.

![Figure 3-4](image)

16. At the cost-minimizing combination of $L$ and $K$, the ratio of $MPL$ to $MPK$, the marginal rate of technical substitution ($MRTS$), equals
   a. 0.64.
   b. 1.5625.
   c. 2.
   d. 2.25.

17. The total cost level associated with the optimal combination of $L$ and $K$ is
   a. $4,000.
   b. $4,100.
   c. $4,405.
   d. $4,750.
18. If the price of capital were to rise to $40, which of the following statements would be true?
   a. If the firm wanted to stay at the same cost level, the output of the firm would have to fall.
   b. If the firm wanted to stay at the same output level, the total cost would have to rise.
   c. If the firm stayed at the same output level, it would adjust its input mix to use less capital and more labor.
   d. All of the above.

Problems

The Short-Run Demand for Labor

19. Recall that the marginal revenue product of labor (MRPL) is defined as \( MR \times MPL \).

19a. Using the definitions of marginal revenue and marginal product of labor, prove that \( MR \times MPL \)
equals the marginal revenue associated with an additional unit of labor (MRPL).

19b. Explain why the MRPL curve slopes downward.

20. The demand for labor is called a derived demand since without the demand for the final product, there would be no demand for labor. Using the data associated with Figure 3-1 in the Summary section, show what would happen to the demand for labor when each of the following changes takes place.

20a. Suppose the demand for the product increased in such a way that the product price rose to $4. Find the equation for the firm’s new demand curve for labor. What would be the new optimal level of labor assuming \( W \) stays at $10?

20b. In the short run, by definition, the capital stock is fixed. Show what would happen to the demand for labor if the capital stock were fixed at 20 units instead. Find the equation for the firm’s new demand curve for labor. What would be the new optimal level of labor, assuming \( W \) stays at $10?

20c. Finally, show what would happen to the firm’s demand for labor if labor became more productive so that the production function could now be represented by the formula

\[
Q = 2KL - 0.025KL^2,
\]

which would make the marginal product expression at \( K = 10 \)

\[
MP_L = 20 - 0.5L.
\]

Find the equation for the firm’s new demand curve for labor. What would be the new optimal level of labor assuming \( W \) stays at $10?

21. The demand for labor can be expressed in terms of real or nominal (money) wages. Figure 3-1 in the Summary section is expressed in terms of the nominal wage.

21a. Redraw Figure 3-1 expressing the demand for labor in terms of the real wage.
21b. What curve plays the role of the firm’s demand curve for labor when the real wage is plotted on the vertical axis?

22. Suppose the following equations represent the demand for two firms demanding a particular type of labor. The curves are expressed as functions of the real wage.

   Firm 1: \( L_1 = 50 - \frac{W}{P} \).
   Firm 2: \( L_2 = 25 - 0.5\frac{W}{P} \).

22a. Plot the two curves on the same axes and then construct the market demand.

22b. Find the equation for the market demand curve.

The Long-Run Demand for Labor

23. Suppose the firm currently employs 500 workers and 100 units of capital and that the following relationship holds.

\[
\frac{W}{MP_L} = \frac{16}{4} = 4 < \frac{C}{MP_K} = \frac{50}{10} = 5.
\]

Prove that the firm is not at an equilibrium mix of labor and capital by showing there is a window of opportunity for it to reduce its total cost.

*24. Use the data in the Summary section Example problem to answer the following questions.

*24a. Find the substitution and scale effects associated with an increase in the wage from $4 to $9 assuming the firm faces a market demand given by the equation \( P = 56 - 2Q \).

24b. Are labor and capital gross substitutes or gross complements? Will the demand for capital shift right or left as the wage increases?

*25. Use the data in the Summary section Example problem to answer the following questions.

*25a. Find the substitution and scale effects associated with an increase in the price of capital from $16 to $36. Assume the wage rate is constant at $4.

25b. Are labor and capital gross substitutes or gross complements? Will the labor demand curve shift left or right as the price of capital increases?

A Graphical Approach to Labor Demand (Appendix 3A)

26. Consider the isoquants shown in Figure 3-5. Assume the level of capital is fixed at 4 units in the short run.

26a. Find the marginal product of labor associated with a movement from point \( a \) to point \( b \). Do the same for a movement from point \( b \) to point \( c \).
26b. Is the diagram consistent with the notion of a diminishing marginal product of labor? If so, does it help to explain why the marginal product declines?

27. Figure 3-6 depicts a situation where the firm must use capital and labor in a fixed one-to-one proportion. For example, if the firm uses 70 units of capital and 70 units of labor, it will be able to produce 70 units of output. However, if it adds another unit of capital without adding another unit of labor, output would remain at 70 units. Suppose that originally the price of labor is $5, the price of capital is $10, and the optimal level of output is 70.

The cost-minimizing point is where the firm uses 70 units of labor and 70 units of capital (point \(a\)). Now suppose the price of capital rises to $20 and the firm responds by moving to point \(b\).

27a. Find the substitution effect on labor and capital of the capital price change.

27b. Find the scale effect on labor and capital of the capital price change.

27c. Are labor and capital gross substitutes or gross complements?

27d. Has the firm’s total cost level increased or decreased after the change in the price of capital?
Applications

Who Bears the Burden of the Payroll Tax?

28. Consider a labor market where the labor demand and supply curves are given by the equations

Demand: \( W_D = 30 - 0.04L \).

Supply: \( W_S = 0.05L - 15 \).

28a. Calculate the equilibrium wage and employment level.

28b. Suppose the government imposes a payroll tax of $9 per labor unit on the employer. Calculate the new equilibrium wage and employment level. What is the new per-unit cost of labor to the firm?

28c. What percentage of the tax is ultimately paid by the workers? What percentage is paid by the firm?

28d. What similarity do you see between the analysis of payroll tax burdens and proposals that employers be required to provide certain benefits (like health insurance or parental leave) to their employees? What are the likely effects of such mandates?

Effects of Deregulation on the Demand for Labor

*29. The theory behind deregulating various product markets like air travel, trucking, and so on was to break down monopoly power, do away with regulation that was generally ineffective, and make the markets more competitive. Holding all else constant, when monopoly power is broken down, an industry should be able to produce more output at a lower price.

Consider a firm with a production function given by the equation

\[ Q = \sqrt{L} \sqrt{K} \]

In the short run suppose the level of capital is fixed at 16 units. The marginal product of labor in the short run is given by the equation

\[ MP_L = \frac{2}{\sqrt{L}} \]

Suppose initially that a firm has been granted monopoly power by the government and faces a demand curve given by \( P = 20 - 0.5Q \). The firm faces competition in the labor market where the going price of labor is $10. Suppose that regulation is ineffective and the firm acts as a normal profit-maximizing monopolist.

*29a. Find the equation for the firm’s labor demand curve. Find the optimal level of labor for the firm to demand.

*29b. Given your answer to 33a, how much output will the firm produce and what price will it charge?

*29c. Now suppose the market in which the firm sells its product is deregulated and new competitors enter the market. Suppose the price of the product falls to $15. Find the equation for the firm’s demand curve for labor under competition. Using the new demand curve expression, find the optimal level of labor for the firm to demand. How much output will the firm produce now?

*29d. On the same graph, plot the demand curves and the quantity of labor demanded before and after deregulation.
29e. In general (without computing specific numbers), what effect do you think deregulation would have on a firm’s long-run demand for labor? Explain your reasoning.

29f. If regulators are actually effective in keeping a firm from exploiting its monopoly status, some economists suspect that such firms may actually pay a wage that is higher than the going rate. Explain the reasoning behind this argument.

**Wage Subsidies**

*30. Consider a firm that hires low-skilled workers. The firm’s demand for this labor is given by the equation

\[ W = 16 - 0.1L, \]

or equivalently,

\[ L = 160 - 10W. \]

To stimulate the employment of low-skilled workers, suppose the government institutes a wage subsidy program. The program is a “targeted” subsidy in that the firm will receive a subsidy only if it hires people previously on welfare. The program is also a “marginal” or “incremental” subsidy in that the subsidy applies only to new hires made from the targeted groups. The firm will not receive subsidies for existing workers. Finally, the subsidy will be structured so that the firm receives 50% of the difference between the wage they pay and the program’s “target wage” of $8. (If the firm pays the workers $8 or more they receive no subsidy.) Suppose the firm currently pays the going wage for unskilled labor of $4.

30a. Before the subsidy was enacted, what was the quantity of labor demanded? Graph the demand curve before the subsidy and indicate the firm’s wage and employment level.

*30b. Under the program, assuming the wage actually paid is $4, what subsidy does the firm receive for each new hire? What is the effective cost to the firm of each new hire?

*30c. What is the quantity of labor the firm will demand at a wage of $4 under the subsidy program? On the same graph as in 34a, draw the demand for labor under the subsidy program.

*30d. At a wage of $4, is the demand for labor flatter or steeper under the subsidy program? Would the slope increase or decrease if the subsidy were 75% of the difference between the target wage and the actual wage?

*30e. Given the original information, what is the total payment the government must make to the firm? What would the cost to the government be if the subsidy applied to all workers, not just new hires?

*30f. If the original demand for labor were steeper, would the employment effects of the subsidy be larger or smaller? Explain your reasoning.

*30g. Why do subsidy programs targeted to specific groups not always have the type of effect this example predicts?