

Labor Demand

☺☺ Optional practice questions ☺☺

1. Suppose there are two inputs in the production function, labor and capital, and these two inputs are perfect substitutes. The existing technology permits 1 machine to do the work of 3 workers. The firm wants to produce 100 units of output. Suppose the price of capital is \$750 per machine per week. What combination of inputs will the firm use if the weekly salary of each worker is \$300? What combination of inputs will the firm use if the weekly salary of each worker is \$225? What is the elasticity of labor demand as the wage falls from \$300 to \$225?
2. Union A wants to represent workers in a firm that would hire 20,000 workers if the wage rate is \$12 and would hire 10,000 workers if the wage rate is \$15. Union B wants to represent workers in a firm that would hire 30,000 workers if the wage is \$20 and would hire 33,000 workers if the wage is \$15. Which union is likely to organize?
3. Consider a firm for which production depends on two normal inputs, labor and capital, with prices w and r , respectively. Initially the firm faces market prices of $w = 6$ and $r = 4$. These prices then shift to $w = 4$ and $r = 2$.
 - (a) In which direction will the substitution effect change the firm's employment and capital stock?
 - (b) In which direction will the scale effect change the firm's employment and capital stock?
 - (c) Can we say conclusively whether the firm will use more or less labor? More or less capital?
4. What happens to employment in a competitive firm that experiences a technology shock such that at every level of employment its output is 200 units/hour greater than before?
5. Suppose a firm purchases labor in a competitive labor market and sells its product in a competitive product market. The firm's elasticity of demand for labor is -0.4 . Suppose the wage increases by 5 percent. What will happen to the number of workers hired by the firm? What will happen to the marginal productivity of the last worker hired by the firm?
6. How does the amount of unemployment created by an increase in the minimum wage depend on the elasticity of labor demand? Do you think an increase in the minimum wage will have a greater unemployment effect in the fast food industry or in the lawn care/landscaping industry?

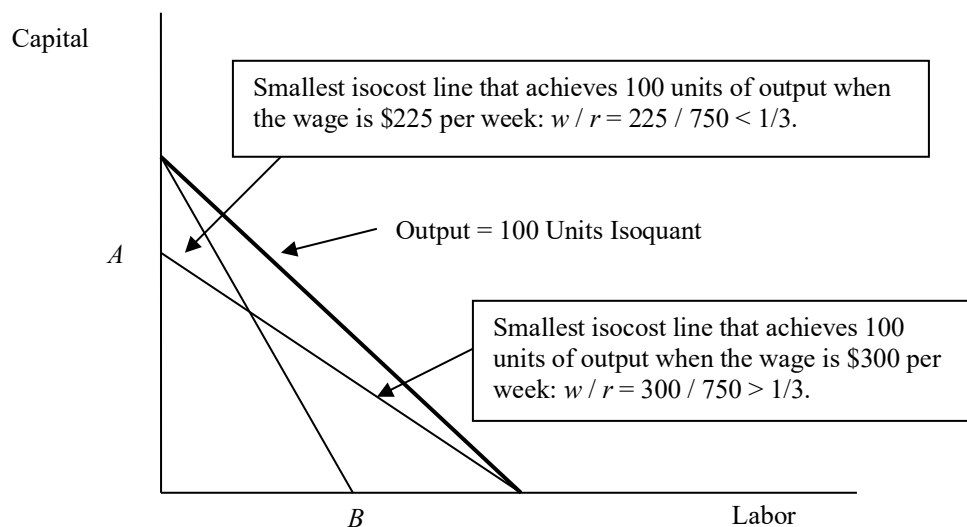
7. Which one of Marshall's rules suggests why labor demand should be relatively inelastic for public school teachers and nurses? Explain.

Answers

1. Suppose there are two inputs in the production function, labor and capital, and these two inputs are perfect substitutes. The existing technology permits 1 machine to do the work of 3 workers. The firm wants to produce 100 units of output. Suppose the price of capital is \$750 per machine per week. What combination of inputs will the firm use if the weekly salary of each worker is \$300? What combination of inputs will the firm use if the weekly salary of each worker is \$225? What is the elasticity of labor demand as the wage falls from \$300 to \$225?

Because labor and capital are perfect substitutes, the isoquant for producing 100 units of output (in bold in the figure below) is linear and the firm will use only labor or only capital, depending on which is relatively cheaper in producing 100 units of output.

The (absolute value of the) slope of the isoquant (MP_E / MP_K) is $1/3$ because 1 machine does the work of 3 workers. When the wage is \$300, the slope of the isocost is $300/750$. The isocost curve, therefore, is steeper than the isoquant, and the firm only hires capital (at point A). When the weekly wage is \$225, the isoquant is steeper than the isocost and the firm hires only labor (at point B).



The elasticity of labor demand is defined as the percentage change in labor divided by the percentage change in the wage. Because the demand for labor goes from 0 to a positive quantity when the wage drops to \$225, the (absolute value of the) elasticity of labor demand is infinity.

2. **Union A wants to represent workers in a firm that would hire 20,000 workers if the wage rate is \$12 and would hire 10,000 workers if the wage rate is \$15. Union B wants to represent workers in a firm that would hire 30,000 workers if the wage is \$20 and would hire 33,000 workers if the wage is \$15. Which union is likely to organize?**

The union will be more likely to attract the workers' support when the elasticity of labor demand (in absolute value) is small. The elasticity of labor demand facing union A is given by:

$$\eta_A = \frac{\% \Delta E}{\% \Delta w} = \frac{(20,000 - 10,000)/20,000}{(12 - 15)/12} = -2.$$

The elasticity of labor demand facing union B is given by:

$$\eta_B = \frac{\% \Delta E}{\% \Delta w} = \frac{(33,000 - 30,000)/33,000}{(15 - 20)/15} \approx -0.45$$

Union B, therefore, is more likely to organize as $|-0.45| < |-2|$.

3. **Consider a firm for which production depends on two normal inputs, labor and capital, with prices w and r , respectively. Initially the firm faces market prices of $w = 6$ and $r = 4$. These prices then shift to $w = 4$ and $r = 2$.**

(a) In which direction will the substitution effect change the firm's employment and capital stock?

Prior to the price shift, the absolute value of the slope of the isocost line (w/r) was 1.5. After the price shift, the slope is 2. In other words, labor has become relatively more expensive than capital. As a result, there will be a substitution away from labor and towards capital (the substitution effect).

(b) In which direction will the scale effect change the firm's employment and capital stock?

Because both prices fall, the marginal cost of production falls, and the firm will want to expand. The scale effect, therefore, increases the demand for both labor and capital (as both are normal inputs).

(c) Can we say conclusively whether the firm will use more or less labor? More or less capital?

The firm will certainly use more capital as the substitution and scale effects reinforce each other in the direction of using more capital. The change in labor hired, however, will depend on whether the substitution or the scale effect for labor dominates.

4. **What happens to employment in a competitive firm that experiences a technology shock such that at every level of employment its output is 200 units/hour greater than before?**

Because output increases by the same amount at every level of employment, the marginal product of labor does not change (and hence, the value of the marginal product of labor does not change). Therefore, as the value of the marginal product of labor will equal the wage rate at the same level of employment as before, the level of employment will not change.

- 5. Suppose a firm purchases labor in a competitive labor market and sells its product in a competitive product market. The firm's elasticity of demand for labor is -0.4 . Suppose the wage increases by 5 percent. What will happen to the number of workers hired by the firm? What will happen to the marginal productivity of the last worker hired by the firm?**

Given the estimates of the elasticity of labor demand and the change in the wage, we have that

$$\eta = \frac{\% \Delta E}{\% \Delta w} = -0.4 \Rightarrow \frac{\% \Delta E}{5\%} = -0.4 \Rightarrow \% \Delta E = -2\% .$$

Thus, the firm hires 2 percent fewer workers. Furthermore, because the labor market is competitive, the marginal worker is paid the value of his marginal product. As the product market is competitive, we also know that the output price does not change so that the marginal productivity of the marginal worker increases by 5 percent.

- 6. How does the amount of unemployment created by an increase in the minimum wage depend on the elasticity of labor demand? Do you think an increase in the minimum wage will have a greater unemployment effect in the fast food industry or in the lawn care/landscaping industry?**

The elasticity of demand (for low-skill workers) is the percent change in labor demanded over the percent change in the wage. When this is low (in absolute value), labor demand is not very responsive to increases in the (minimum) wage. In this case, there will be very small unemployment effects from increasing the minimum wage. When the elasticity of demand is large in absolute value, however, there will be substantial unemployment effects when the minimum wage is increased.

It is probably likely that the unemployment effect from an increase in the minimum wage would be more pronounced in the fast food industry than in the lawn care/landscaping industry. The fast food industry has witnessed a large amount of automation (and even outsourcing), and could experience more. Such possible reactions make labor demand more elastic. In contrast, the lawn care/landscaping industry requires workers (who use machines) to cut lawns, install sprinklers, etc. Such reliance on labor, therefore, may result in more inelastic demand for labor.

7. Which one of Marshall's rules suggests why labor demand should be relatively inelastic for public school teachers and nurses? Explain.

Public school teachers and nurses both help produce a good that is price inelastic – in the United States, at least, society will always purchase education and health care. Likewise, education and healthcare do not face strong competition from substitute goods. Finally, the production processes for education and healthcare both require teachers and nurses. And though these talents can be substituted for to some degree by other forms of labor or capital, both are crucial to the production process. Thus, other inputs (computers, doctors, etc.) cannot readily replace teaching or nursing services, and therefore the supply elasticity of other factors of production is not very elastic for teachers or nurses. For all three of these rules, therefore, the labor demand for public school teachers is likely similar to the labor demand for nurses.

These two occupations, however, differ in Marshall's fourth rule. Public school teacher salaries are estimated to be between 50% and 80% of all expenditures on primary and secondary education. In contrast, expenditures on nursing are a much lower percentage of the total cost of health care. For this rule, therefore, the demand for nurses is more inelastic than is the demand for public school teachers.