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## Input Demand: The Labor and Land Markets



# 10

**CHAPTER OUTLINE**

**Input Markets: Basic Concepts**  
 Demand for Inputs: A *Derived* Demand  
 Inputs: Complementary and Substitutable  
 Diminishing Returns  
 Marginal Revenue Product

**Labor Markets**  
 A Firm Using Only One Variable Factor of Production: Labor  
 A Firm Employing Two Variable Factors of Production in the Short and Long Run  
 Many Labor Markets

**Land Markets**  
 Rent and the Value of Output Produced on Land

**The Firm's Profit-Maximizing Condition in Input Markets**

**Input Demand Curves**  
 Shifts in Factor Demand Curves

**Looking Ahead**

### Input Markets: Basic Concepts

#### Demand for Inputs: A *Derived* Demand

**derived demand** The demand for resources (inputs) that is dependent on the demand for the outputs those resources can be used to produce.

Inputs are demanded by a firm if and only if households demand the good or service provided by that firm.

**productivity of an input** The amount of output produced per unit of that input.

#### Inputs: Complementary and Substitutable

Inputs can be *complementary* or *substitutable*. Two inputs used together may enhance, or complement, each other. This means that a firm's input demands are tightly linked to one another.



When two inputs are used together, we say that the inputs are:

- Substitutable.
- Complementary.
- Highly productive.
- Homogeneous.
- Dependent of the demand for the output they produce.

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## Diminishing Returns

**marginal product of labor ( $MP_L$ )** The additional output produced by 1 additional unit of labor.

**TABLE 10.1** Marginal Revenue Product per Hour of Labor in Sandwich Production (One Grill)

(1) Total Labor Units (Employees)	(2) Total Product (Sandwiches per Hour)	(3) Marginal Product of Labor ( $MP_L$ ) (Sandwiches per Hour)	(4) Price ( $P_X$ ) (Value Added per Sandwich) <sup>a</sup>	(5) Marginal Revenue Product ( $MP_L \times P_X$ ) (per Hour)
0	0	–	–	–
1	10	10	\$0.50	\$5.00
2	25	15	0.50	7.50
3	35	10	0.50	5.00
4	40	5	0.50	2.50
5	42	2	0.50	1.00
6	42	0	0.50	0.00

<sup>a</sup>The "price" is essentially profit per sandwich; see discussion in text.

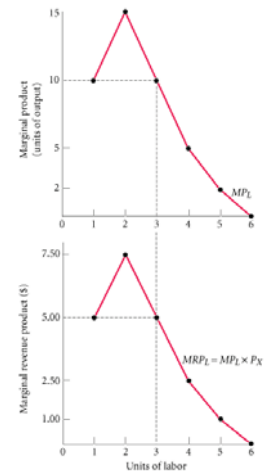
### Marginal Revenue Product

**marginal revenue product ( $MRP_L$ )** The additional revenue a firm earns by employing 1 additional unit of input, *ceteris paribus*.  $MRP_L = MP_L \times P_X$

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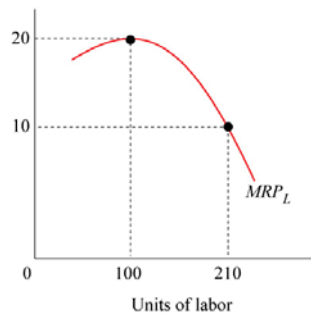
**FIGURE 10.1** Deriving a Marginal Revenue Product Curve from Marginal Product

The marginal revenue product of labor is the price of output,  $P_X$ , times the marginal product of labor,  $MP_L$ .



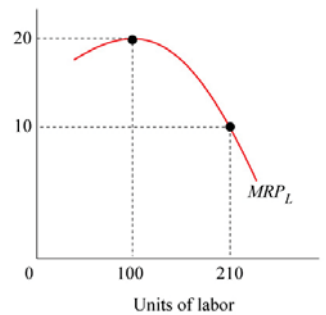
Refer to the figure. What explains the shape of this curve in a framework of competitive input and output markets?

- Increasing marginal product of labor but decreasing output price.
- Decreasing marginal product of labor along with lower output price.
- Diminishing marginal returns and, consequently, decreasing marginal product of labor, but not output price.
- Increasing marginal returns but decreasing output price.
- Increasing output price, decreasing marginal product of labor, and diminishing returns.



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## ECONOMICS IN PRACTICE

### Do Managers Matter?

Managers can affect the productivity of the people who work for them.

In a recent field experiment on a group of large Indian textile firms, researchers randomly sorted those firms into one of two groups. In the treatment group firm managers were taught a range of operational practices that earlier research had suggested might be effective. A second, control group received a shorter period of diagnostic consulting, with no training.

The results? Within the first year after treatment, productivity in the treated plants increased by 17%.

### THINKING PRACTICALLY

- Many of the firms treated had multiple plants. After the researchers left, what do you think they did about training in their other plants?

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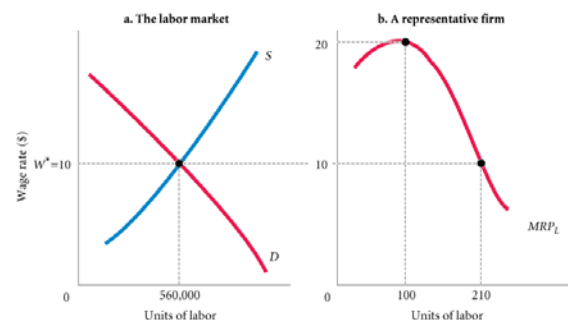
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## Labor Markets

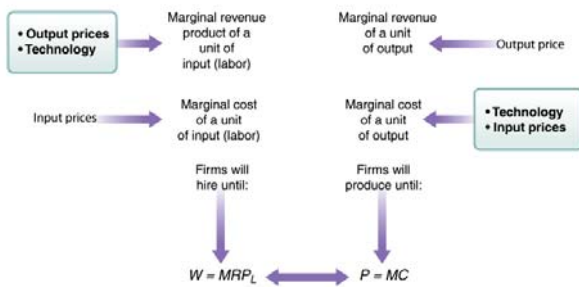
### A Firm Using Only One Variable Factor of Production: Labor



**FIGURE 10.2** Marginal Revenue Product and Factor Demand for a Firm Using One Variable Input (Labor)

A competitive firm using only one variable factor of production will use that factor as long as its marginal revenue product exceeds its unit cost. A perfectly competitive firm will hire labor as long as  $MRP_L$  is greater than the going wage,  $W$ . The hypothetical firm will demand 210 units of labor.

## Comparing Marginal Revenue and Marginal Cost to Maximize Profits



▲ FIGURE 10.3 The Two Profit-Maximizing Conditions Are Simply Two Views of the Same Choice Process



From the viewpoint of the business firm, the market wage is conceptually the same as:

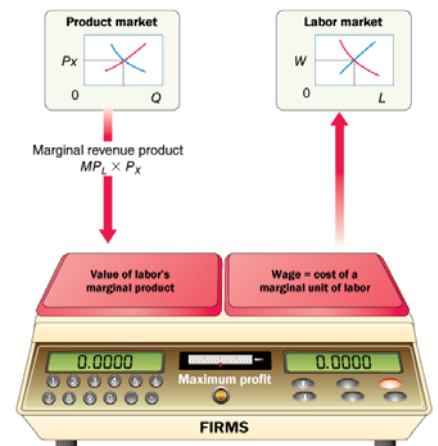
- The marginal cost of a unit of labor.
- Marginal revenue.
- Marginal revenue product.
- Marginal product.
- The firm's demand for labor.

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► FIGURE 10.4 The Trade-Off Facing Firms

Firms weigh the cost of labor as reflected in wage rates against the value of labor's marginal product. Assume that labor is the only variable factor of production. Then, if society values a good more than it costs firms to hire the workers to produce that good, the good will be produced.



## Deriving Input Demands

For the small sandwich shop, calculating the marginal product of a variable input (labor) and marginal revenue product was easy. Although it may be more complex, the decision process is essentially the same for both big corporations and small proprietorships.

When an airline hires more flight attendants, for example, it increases the quality of its service to attract more passengers and thus to sell more of its product. In deciding how many flight attendants to hire, the airline must figure out how much new revenue the added attendants are likely to generate relative to their wages.

In making your own decisions, you also compare marginal gains with input costs in the presence of diminishing returns.

## A Firm Employing Two Variable Factors of Production in the Short and Long Run

You have seen that inputs can be complementary or substitutable. Land, labor, and capital are used *together* to produce outputs. At the same time, though, land, labor, and capital can also be *substituted* for one another.

In firms employing just one variable factor of production, a change in the price of that factor affects only the demand for the factor itself. When more than one factor can vary, however, we must consider the impact of a change in one factor price on the demand for other factors as well.



In order to maximize profit, a firm will hire workers up until:

- $P = MC$ .
- $MR = MC$
- $W = MP_L$
- $W = MRP_L$
- $P = MC = SRAC = LRAC$

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### Substitution and Output Effects of a Change in Factor Price

**TABLE 10.2** Response of a Firm to an Increasing Wage Rate

Technology	Input Requirements per Unit of Output		Unit Cost if $P_L = \$1$ $P_K = \$1$	Unit Cost if $P_L = \$2$ $P_K = \$1$
	$K$	$L$	$(P_L \times L) + (P_K \times K)$	$(P_L \times L) + (P_K \times K)$
A (capital intensive)	10	5	\$15	\$20
B (labor intensive)	3	10	\$13	\$23

**TABLE 10.3** The Substitution Effect of an Increase in Wages on a Firm Producing 100 Units of Output

	To Produce 100 Units of Output		
	Total Capital Demanded	Total Labor Demanded	Total Variable Cost
When $P_L = \$1$ , $P_K = \$1$ , firm uses technology B	300	1,000	\$1,300
When $P_L = \$2$ , $P_K = \$1$ , firm uses technology A	1,000	500	\$2,000

**factor substitution effect** The tendency of firms to substitute away from a factor whose price has risen and toward a factor whose price has fallen.

**output effect of a factor price increase (decrease)** When a firm decreases (increases) its output in response to a factor price increase (decrease), this decreases (increases) its demand for all factors.

### Many Labor Markets

Each market has a set of skills associated with it and a supply of people with the requisite skills.

If labor markets are competitive, the wages in those markets are determined by the interaction of supply and demand.

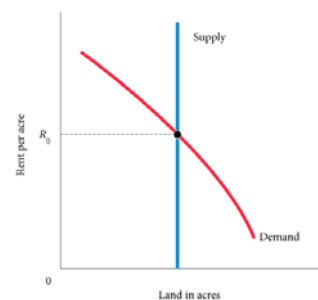
As we have seen, firms will hire workers only as long as the value of their product exceeds the relevant market wage.

This is true in all competitive labor markets.

### Land Markets

**demand-determined price** The price of a good that is in fixed supply; it is determined exclusively by what households and firms are willing to pay for the good.

**pure rent** The return to any factor of production that is in fixed supply.



**FIGURE 10.5** The Rent on Land Is Demand Determined

Because land in general (and each parcel in particular) is in fixed supply, its price is demand determined. Graphically, a fixed supply is represented by a vertical, perfectly inelastic supply curve. Rent,  $R_0$ , depends exclusively on demand—what people are willing to pay.



What is the special feature that makes land different from capital and labor?

- Land is in fixed supply, which means that its price is strictly determined by the amount available, or supply.
- Land is in fixed supply, which means that its price is strictly determined by demand.
- The supply of land is perfectly elastic.
- The demand for land is perfectly inelastic.
- Unlike capital and labor, both supply and demand for land determine the price of land.

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## Rent and the Value of Output Produced on Land

A firm will pay for and use land as long as the revenue earned from selling the product produced on that land is sufficient to cover the price of the land.

Stated in equation form, the firm will use land up to the point at which  $MRP_A = P_A$ , where  $A$  is land (acres).

The allocation of a given plot of land among competing uses thus depends on the trade-off between competing products that can be produced there.

One final word. Because land cannot be moved physically, the value of any one parcel depends to a large extent on the uses to which adjoining parcels are put.

## ECONOMICS IN PRACTICE

### Valuing Land

The *New York Times*, as well as a number of other newspapers and magazines, now and again run columns showing us what some price—say \$350,000—would buy us in the way of a house in various parts of the United States. The range in size and quality of houses is quite large. And yet, construction costs are actually quite similar across the country.

Housing price differences are driven much more by differences in land prices. Land, after all, in a particular location is inelastically supplied. Price differences are demand determined, given the fixed supply.

### THINKING PRACTICALLY

- Europe has been expanding its range of high-speed trains. What do you think this might do to land prices in the areas served by these trains?

## The Firm's Profit-Maximizing Condition in Input Markets

The profit-maximizing condition for the perfectly competitive firm is

$$P_L = MRP_L = (MP_L \times P_X)$$

$$P_K = MRP_K = (MP_K \times P_X)$$

$$P_A = MRP_A = (MP_A \times P_X)$$

where  $L$  is labor,  $K$  is capital,  $A$  is land (acres),  $X$  is output, and  $P_X$  is the price of that output.

If all the conditions hold at the same time, it is possible to rewrite them another way:

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K} = \frac{MP_A}{P_A} = \frac{1}{P_X}$$



Consider the inequality below. Assuming diminishing returns to both capital and labor, how can the firm produce more output at a lower cost?

$$\frac{MP_L}{P_L} < \frac{MP_K}{P_K}$$

- By increasing the amount of labor and decreasing the amount of capital used.
- By increasing the amount of capital and decreasing the amount of labor used.
- By increasing both labor and capital.
- By decreasing both labor and capital.
- By maintaining the same combination of inputs currently in use.

Consider the inequality below. Assuming diminishing returns to both capital and labor, how can the firm produce more output at a lower cost?

$$\frac{MP_L}{P_L} < \frac{MP_K}{P_K}$$

- a. By increasing the amount of labor and decreasing the amount of capital used.
- b. By increasing the amount of capital and decreasing the amount of labor used.**
- c. By increasing both labor and capital.
- d. By decreasing both labor and capital.
- e. By maintaining the same combination of inputs currently in use.

## Input Demand Curves

### Shifts in Factor Demand Curves

#### The Demand for Outputs

If product demand increases, product price will rise and marginal revenue product (factor demand) will increase—the *MRP* curve will shift to the right. If product demand declines, product price will fall and marginal revenue product (factor demand) will decrease—the *MRP* curve will shift to the left.

#### The Quantity of Complementary and Substitutable Inputs

The production and use of capital enhances the productivity of labor and normally increases the demand for labor and drives up wages.

## Shifts in Factor Demand Curves

### The Prices of Other Inputs

When a firm has a choice among alternative technologies, the choice it makes depends to some extent on relative input prices.

### Technological Change

**technological change** The introduction of new methods of production or new products intended to increase the productivity of existing inputs or to raise marginal products.

## Looking Ahead

To show the connection between output and input markets, this chapter examined the three fundamental decisions profit-maximizing firms make from the perspective of input markets.

The next chapter takes up the complexity of what we have been loosely calling the “capital market.”

Once we examine the nature of overall competitive equilibrium in Chapter 12, we can finally begin relaxing some of the assumptions that have restricted the scope of our inquiry—most importantly, the assumption of perfect competition in input and output markets.

## REVIEW TERMS AND CONCEPTS

demand-determined price	output effect of a factor price increase (decrease)
derived demand	productivity of an input
factor substitution effect	pure rent
marginal product of labor ( $MP_L$ )	technological change
marginal revenue product ( $MRP$ )	Equations:
	$MRP_L = MP_L \times P_X$