In this chapter, look for the answers to these questions:

- What determines a competitive firm’s demand for labor?
- How does labor supply depend on the wage? What other factors affect labor supply?
- How do various events affect the equilibrium wage and employment of labor?
- How are the equilibrium prices and quantities of other inputs determined?

The Markets for the Factors of Production

- Factors of production are the inputs used to produce goods and services.
- The demand for a factor of production is a derived demand.
- A firm’s demand for a factor of production is derived from its decision to supply a good in another market.

Factors of Production and Factor Markets

- **Factors of production**: the inputs used to produce goods and services.
  - Labor
  - Land
  - **Capital**: the equipment and structures used to produce goods and services.
- Prices and quantities of these inputs are determined by supply & demand in factor markets.
Two Assumptions

1. We assume all markets are competitive.
   - The typical firm is a price taker
   - in the market for the product it produces
   - in the labor market

2. We assume that firms care only about maximizing profits.
   - Each firm’s supply of output and demand for inputs are derived from this goal.

THE DEMAND FOR LABOR

- Labor markets, like other markets in the economy, are governed by the forces of supply and demand.
- Most labor services, rather than being final goods ready to be enjoyed by consumers, are inputs into the production of other goods.

The Production Function and the Marginal Product of Labor

- The production function illustrates the relationship between the quantity of inputs used and the quantity of output of a good.
- Table 1 How the Competitive Firm Decides How Much Labor to Hire
The Production Function and the Marginal Product of Labor

- The marginal product of labor is the increase in the amount of output from an additional unit of labor.
  - \( MPL = \frac{\Delta Q}{\Delta L} \)
  - \( MPL = \frac{(Q_2 - Q_1)}{(L_2 - L_1)} \)

Diminishing Marginal Product of Labor

- As the number of workers increases, the marginal product of labor declines.
- As more and more workers are hired, each additional worker contributes less to production than the prior one.
- The production function becomes flatter as the number of workers rises.
- This property is called diminishing marginal product.
- Diminishing marginal product refers to the property whereby the marginal product of an input declines as the quantity of the input increases.

The Value of the Marginal Product and the Demand for Labor

- The value of the marginal product is the marginal product of the input multiplied by the market price of the output.
  - \( VMPL = MPL \times P \)
- The value of the marginal product (also known as marginal revenue product) is measured in dollars.
- It diminishes as the number of workers rises because the market price of the good is constant.
The Value of the Marginal Product and the Demand for Labor

- To maximize profit, the competitive, profit-maximizing firm hires workers up to the point where the value of the marginal product of labor equals the wage.
- $VMPL = \text{Wage}$
- The value-of-marginal-product curve is the labor demand curve for a competitive, profit-maximizing firm.

Computing MPL and VMPL

$P = $5/bushel. Find $MPL$ and $VMPL$, fill them in the blank spaces of the table. Then graph a curve with $VMPL$ on the

<table>
<thead>
<tr>
<th>$L$ (no. of workers)</th>
<th>$Q$ (bushels of wheat)</th>
<th>$MPL$</th>
<th>$VMPL$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FYI—Input Demand and Output Supply: Two Sides of the Same Coin

- When a competitive firm hires labor up to the point at which the value of the marginal product equals the wage, it also produces up to the point at which the price equals the marginal cost.
What Causes the Labor-Demand Curve to Shift?

- The Output Price
- Technological Change
- The Supply of Other factors
  - Example: If firm gets more equipment (capital), then workers will be more productive; $MPL$ and $VMPL$ rise, labor demand shifts upward.

Things that Shift the Labor Demand Curve

- Changes in the output price, $P$
- Technological change (affects $MPL$)
- The supply of other factors (affects $MPL$)
  - Example: If firm gets more equipment (capital), then workers will be more productive; $MPL$ and $VMPL$ rise, labor demand shifts upward.

The Connection Between Input Demand & Output Supply

- Recall: marginal cost ($MC$)
  - cost of producing an additional unit of output
  - $MC = \frac{\Delta TC}{\Delta Q}$, where $TC = $ total cost
- Suppose $W = $2500, $MPL = 500$ bushels
- If Farmer Jack hires another worker,
  - $\Delta TC = $2500, $\Delta Q = 500$ bushels
  - $MC = \frac{2500}{500} = $5$ per bushel
- In general: $MC = \frac{W}{MPL}$

The Connection Between Input Demand & Output Supply

- In general: $MC = \frac{W}{MPL}$
- Notice:
  - To produce additional output, hire more labor.
  - As $L$ rises, $MPL$ falls…
    - causing $W/MPL$ to rise…
    - causing $MC$ to rise.
- Hence, diminishing marginal product and increasing marginal cost are two sides of the same coin.
The Connection Between Input Demand & Output Supply

- The competitive firm’s rule for demanding labor:
  \[ P \times MPL = W \]
- Divide both sides by \( MPL \):
  \[ P = W/MPL \]
- Substitute \( MC = W/MPL \) from previous slide:
  \[ P = MC \]
- This is the competitive firm’s rule for supplying output.
- Hence, input demand and output supply are two sides of the same coin.

THE SUPPLY OF LABOR

- The Trade-off between Work and Leisure
  - The labor supply curve reflects how workers’ decisions about the labor-leisure trade-off respond to changes in opportunity cost.
  - An upward-sloping labor supply curve means that an increase in the wages induces workers to increase the quantity of labor they supply.

The Labor Supply Curve

An increase in \( W \) is an increase in the opp. cost of leisure. People respond by taking less leisure and by working more.

What Causes the Labor Supply Curve to Shift?

- Changes in Tastes
- Changes in Alternative Opportunities
- Immigration
EQUILIBRIUM IN THE LABOR MARKET

- The wage adjusts to balance the supply and demand for labor.
- The wage equals the value of the marginal product of labor.

Shifts in Labor Supply

- Labor supply and labor demand determine the equilibrium wage.
- Shifts in the supply or demand curve for labor cause the equilibrium wage to change.
Shifts in Labor Supply

- An increase in the supply of labor:
  - Results in a surplus of labor.
  - Puts downward pressure on wages.
  - Makes it profitable for firms to hire more workers.
  - Results in diminishing marginal product.
  - Lowers the value of the marginal product.
  - Gives a new equilibrium.

Shifts in Labor Demand

- An increase in the demand for labor:
  - Makes it profitable for firms to hire more workers.
  - Puts upward pressure on wages.
  - Raises the value of the marginal product.
  - Gives a new equilibrium.

Changes in labor-market equilibrium

In each of the following scenarios, use a diagram of the market for auto workers to find the effects on the wage and number of auto workers employed.

A. Baby Boomers in the auto industry retire.
B. Widespread recalls of U.S. autos shift car buyers’ demand toward imported autos.
C. Technological progress boosts productivity in the auto manufacturing industry.
**Answers**

The retirement of Baby Boomer auto workers shifts supply leftward. 
*W* rises, *L* falls.

The market for autoworkers

![](image1)

**Answers**

A fall in the demand for U.S. autos reduces *P*. 
At each *L*, *VMPL* falls. 
Labor demand curve shifts down. 
*W* and *L* both fall.

The market for autoworkers

![](image2)

**Answers**

At each *L*, *MPL* rises due to tech. progress. 
*VMPL* rises and labor demand curve shifts upward. 
*W* and *L* increase.

The market for autoworkers

![](image3)

**Table 2 Productivity and Wage Growth in the United States**

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Growth Rate of Productivity</th>
<th>Growth Rate of Real Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1959–2003</td>
<td>2.1%</td>
<td>2.0%</td>
</tr>
<tr>
<td>1959–1973</td>
<td>2.9</td>
<td>2.8</td>
</tr>
<tr>
<td>1973–1995</td>
<td>1.4</td>
<td>1.2</td>
</tr>
<tr>
<td>1995–2003</td>
<td>3.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Source: *Economic Report of the President 2005*, Table B-49. Growth in productivity is measured here as the annualized rate of change in output per hour in the nonfarm business sector. Growth in real wages is measured as the annualized change in compensation per hour in the nonfarm business sector divided by the implicit price deflator for that sector. These productivity data measure average productivity—the quantity of output divided by the quantity of labor—rather than marginal productivity, but average and marginal productivity are thought to move closely together.
THE OTHER FACTORS OF PRODUCTION: LAND AND CAPITAL

- **Capital** refers to the equipment and structures used to produce goods and services.
  - The economy’s capital represents the accumulation of goods produced in the past that are being used in the present to produce new goods and services.

OTHER FACTORS OF PRODUCTION: LAND AND CAPITAL

- Prices of Land and Capital
  - The purchase price is what a person pays to own a factor of production indefinitely.
  - The rental price is what a person pays to use a factor of production for a limited period of time.
- The rental price of land and the rental price of capital are determined by supply and demand.
  - The firm increases the quantity hired until the value of the factor’s marginal product equals the factor’s price.

Equilibrium in the Markets for Land and Capital

- Each factor’s rental price must equal the value of its marginal product.
- They each earn the value of their marginal contribution to the production process.
Linkages among the Factors of Production

- Factors of production are used together.
  - The marginal product of any one factor depends on the quantities of all factors that are available.
- A change in the supply of one factor alters the earnings of all the factors.
- A change in earnings of any factor can be found by analyzing the impact of the event on the value of the marginal product of that factor.