The Markets for the Factors of Production
Factors of Production

• Factors of production
  – Inputs used to produce goods and services
    • Labor
    • Land
    • Capital

• Demand for a factor of production
  – Derived demand
    • From firm’s decision to supply a good in another market
The Demand for Labor

- **Labor market**
  - Governed by supply and demand

- **Labor demand**
  - Derived demand
  - Labor services = inputs into the production of other goods
The Versatility of Supply and Demand

(a) The market for apples

(b) The market for apple pickers

The basic tools of supply and demand apply to goods and to labor services. Panel (a) shows how the supply and demand for apples determine the price of apples. Panel (b) shows how the supply and demand for apple pickers determine the wage of apple pickers.
The Demand for Labor

• Assumptions for the competitive firm
  – Firm is competitive in both markets
    • For goods and for labor
    • Price taker
      – Pay the market wage
      – Get the market price for goods
  • Decide
    – Quantity of goods to sell
    – Quantity of labor to hire
  – Firm is profit-maximizing
The Demand for Labor

• Production function
  – Relationship between the quantity of inputs used to make a good
  – And the quantity of output of that good
  – Becomes flatter as the quantity of input increases
The Demand for Labor

• Marginal product of labor (MPL)
  – Increase in the amount of output
  – From an additional unit of labor

• Diminishing marginal product
  – The marginal product of an input declines
  – As the quantity of the input increases
  – Explains the shape of the production function
### Table 1
How the Competitive Firm Decides How Much Labor to Hire

<table>
<thead>
<tr>
<th>Labor ($L$)</th>
<th>Output ($Q$)</th>
<th>Marginal Product of Labor ($MPL = \Delta Q/\Delta L$)</th>
<th>Value of the Marginal Product of Labor ($VMPL = P \times MPL$)</th>
<th>Wage ($W$)</th>
<th>Marginal Profit ($\Delta Profit = VMPL - W$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 workers</td>
<td>0 bushels</td>
<td>100 bushels</td>
<td>$1,000$</td>
<td>$500$</td>
<td>$500$</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
<td>80</td>
<td>800</td>
<td>500</td>
<td>300</td>
</tr>
<tr>
<td>2</td>
<td>180</td>
<td>60</td>
<td>600</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>240</td>
<td>40</td>
<td>400</td>
<td>500</td>
<td>$-100$</td>
</tr>
<tr>
<td>4</td>
<td>280</td>
<td>20</td>
<td>200</td>
<td>500</td>
<td>$-300$</td>
</tr>
<tr>
<td>5</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Production Function

The production function shows how an input into production (apple pickers) influences the output from production (apples). As the quantity of the input increases, the production function gets flatter, reflecting the property of diminishing marginal product.
The Demand for Labor

• Value of the marginal product of labor (VMPL)
  – Marginal product of labor times the price of the output
  – Marginal revenue product
    • Additional revenue from hiring one additional unit of labor
  – Diminishes as the number of workers rises
The Value of the Marginal Product of Labor

This figure shows how the value of the marginal product (the marginal product times the price of the output) depends on the number of workers. The curve slopes downward because of diminishing marginal product. For a competitive, profit-maximizing firm, this value-of-marginal-product curve is also the firm’s labor-demand curve.
The Demand for Labor

- Competitive, profit-maximizing firm
  - Hires workers up to the point where the value of the marginal product of labor = wage

- The value-of-marginal-product curve
  - Is the labor-demand curve

- Labor-demand curve
  - Reflects the value of marginal product of labor
The Demand for Labor

• Shift in the labor-demand curve
  – Change in the output price
    • Demand for labor: $\text{VMPL} = \text{MPL} \times P$ of output
  – Technological change
    • Technological advance
      – Can raise MPL: increase demand for labor
    • Labor-saving technology
      – Can reduce MPL: decrease demand for labor
  – Supply of other factors
    • Affect marginal product of other factor
The Supply of Labor

• Trade-off
  – Work vs. leisure

• Labor-supply curve
  – Reflects how workers’ decisions about the labor-leisure trade-off
  – Respond to a change in opportunity cost of leisure

“I really didn’t enjoy working five days a week, fifty weeks a year for forty years, but I needed the money.”
The Supply of Labor

• Shift in the labor-supply curve
  – Changes in tastes
    • Change in attitude toward work
  – Changes in alternative opportunities
    • Opportunities available in other labor markets
  – Immigration
    • Movement of workers from region to region or country to country
Equilibrium in the Labor Market

• **Wages in competitive labor markets**
  – Adjusts to balance the supply & demand for labor
  – Equals the value of the marginal product of labor

• **Changes in supply or demand for labor**
  – Change the equilibrium wage
  – Change the value of the marginal product by the same amount
Like all prices, the price of labor (the wage) depends on supply and demand. Because the demand curve reflects the value of the marginal product of labor, in equilibrium workers receive the value of their marginal contribution to the production of goods and services.
Equilibrium in the Labor Market

• Increase in supply
  – Decrease in wage
    • Lower marginal product of labor
    • Lower value of marginal product of labor
  – Higher employment
When labor supply increases from $S_1$ to $S_2$, perhaps because of an immigration of new workers, the equilibrium wage falls from $W_1$ to $W_2$. At this lower wage, firms hire more labor, so employment rises from $L_1$ to $L_2$. The change in the wage reflects a change in the value of the marginal product of labor: With more workers, the added output from an extra worker is smaller.
Equilibrium in the Labor Market

• Increase in demand
  – Higher wage
    • No change in marginal product of labor
    • Higher value of marginal product of labor
  – Higher employment
A Shift in Labor Demand

When labor demand increases from \( D_1 \) to \( D_2 \), perhaps because of an increase in the price of the firm’s output, the equilibrium wage rises from \( W_1 \) to \( W_2 \), and employment rises from \( L_1 \) to \( L_2 \). The change in the wage reflects a change in the value of the marginal product of labor: With a higher output price, the added output from an extra worker is more valuable.

1. An increase in labor demand . . .

2. . . . increases the wage . . .

3. . . . and increases employment.

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Productivity and wages

• Standard of living
  – Depends on our ability to produce goods and services

• Wages = productivity
  – As measured by the value of the marginal product of labor
  – Highly productive workers are highly paid
  – Less productive workers are less highly paid
Productivity and wages

• Workers today
  – Are better off than workers in previous generations

• Productivity real wages growth
  – 1959 to 2012
    • Productivity (output per hour of work)
      – Grew about 2.1% per year
    • Real wages (wages adjusted for inflation)
      – Grew at 1.8% per year
    • Productivity & real wages double every 35 years
Productivity and wages

• **Productivity real wages growth**
  
  – 1973 – 1995: significant slowdown in productivity growth (from 2.8 to 1.4%)
    • Slowdown in real wage growth: from 2.8 to 1.2%
  
  – 1995 – 2012: productivity growth = 2.3% per year
    • Real wages grew by 1.9% per year
### 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>1959–2012</td>
<td>2.1%</td>
<td>1.8%</td>
</tr>
<tr>
<td>1959–1973</td>
<td>2.8</td>
<td>2.8</td>
</tr>
<tr>
<td>1973–1995</td>
<td>1.4</td>
<td>1.1</td>
</tr>
<tr>
<td>1995–2012</td>
<td>2.3</td>
<td>1.9</td>
</tr>
</tbody>
</table>


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.
Land and Capital

• **Capital**
  – Equipment and structures used to produce goods and services

• **Equilibrium**
  – Purchase price
    • Price a person pays to own that factor of production indefinitely
  – Rental price
    • Price a person pays to use that factor for a limited period of time
Equilibrium: Land and Capital

- **Wage**
  - Rental price of labor

- **Rental price of land & capital**
  - Determined by supply and demand
  - Demand – derived demand
    - Reflects marginal productivity of the factor

- **Each factor’s rental price**
  - Value of marginal product for the factor
Supply and demand determine the compensation paid to the owners of land, as shown in panel (a), and the compensation paid to the owners of capital, as shown in panel (b). The demand for each factor, in turn, depends on the value of the marginal product of that factor.
Equilibrium: Land and Capital

• Equilibrium purchase price depends on
  – Current value of the marginal product
  – Value of the marginal product expected to prevail in the future
Land and Capital

- **Linkages among the factors of production**
  - Price paid to any factor of production
    - $= \text{Value of the marginal product of that factor}$
  - Marginal product of any factor depends on
    - Quantity of that factor that is available

- **Diminishing marginal product**
  - Factor in abundant supply
    - Low marginal product
    - Low price
Land and Capital

• Diminishing marginal product
  – Factor in scarce supply
    • High marginal product
    • High price
• Change in supply of a factor
  – Change in equilibrium factor price
  – Change in earnings of the other factors
The economics of the *Black Death*

- 14th century Europe, Black Death (bubonic plague)
  - Wiped out about one-third of the population within a few years
  - Grisly natural experiment to test the theory of factor markets

*Workers who survived the plague were lucky in more ways than one.*
The economics of the *Black Death*

**Effects of the Black Death on survivors**

- Reduced population: Smaller supply of workers
- Marginal product of labor rises: Higher wages
  - Wages doubled
  - Economic prosperity for peasant classes
- Marginal product of land fell: Lower rents
  - Rents declined 50% or more
  - Reduced income for the landed classes