Theory of the Firm
Introduction and Description

- We will assume that firms want to maximize their profits.
- However, depending on the market structure of the industry, such behavior has greatly different effects on society and the economy.
- We will use models and analytical skills to examine the behavior and effects of firms operating under different types of market structure.
Characteristics of Market Structures

- **Perfect competition**
  - A market in which there are many firms
  - Each selling identical product
  - Many buyers
  - No barriers to the entry of new firms into the industry
  - No advantage to established firms
  - Buyers and sellers are well informed about prices.

- **Monopolistic competition**
  - A market in which a large number of firms compete by making similar but slightly different products.
Characteristics of Market Structures

- Oligopoly
  - A market in which a small number of independent firms compete.

- Monopoly
  - A market in which one firm sells a good or service that has no close substitutes and a barrier blocks the entry of new firms.
## Different Types of Market Structures

<table>
<thead>
<tr>
<th>Market Structure</th>
<th>Number of Firms</th>
<th>Differentiated or Homogeneous Product</th>
<th>Ease of Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfect Competition</td>
<td>Very many</td>
<td>( H )</td>
<td>Very easy</td>
</tr>
<tr>
<td>Monopolistic</td>
<td>Many</td>
<td>( D )</td>
<td>Relatively easy</td>
</tr>
<tr>
<td>Competition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oligopoly</td>
<td>Few</td>
<td>( H/D )</td>
<td>Not easy</td>
</tr>
<tr>
<td>Monopoly</td>
<td>One</td>
<td>Only product of its kind (no close substitute)</td>
<td>Impossible</td>
</tr>
</tbody>
</table>
## Activity 24 Answer Key, part 2

<table>
<thead>
<tr>
<th>Market Structure</th>
<th>Price-Setting Power</th>
<th>Nonprice Competition</th>
<th>Allocative and Productive Efficiency</th>
<th>Long-Run Profits</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfect Competition</td>
<td><em>Nil (price taker)</em></td>
<td>None</td>
<td><em>Highly efficient</em></td>
<td>0</td>
<td>Doesn’t exist; agriculture close</td>
</tr>
<tr>
<td>Monopolistic Competition</td>
<td><em>Somewhat</em></td>
<td>Considerable</td>
<td><em>Less efficient than PC</em></td>
<td>0</td>
<td>Fast food, retail stores, cosmetics</td>
</tr>
<tr>
<td>Oligopoly</td>
<td><em>Limited</em></td>
<td>Considerable for a differentiated oligopoly</td>
<td><em>Less efficient than PC</em></td>
<td>Positive</td>
<td>Cars, steel, soft drinks, cereals, computers</td>
</tr>
<tr>
<td>Monopoly</td>
<td><em>Absolute (price maker)</em></td>
<td>Somewhat</td>
<td><em>Inefficient</em></td>
<td>High</td>
<td>Small-town newspaper, rural gas station</td>
</tr>
</tbody>
</table>
Understanding the Differences

a) What is the difference between homogeneous and differentiated products?

b) What is the difference between perfect competition and monopolistic competition?

c) Is monopolistic competition close to monopoly?
Understanding the Differences

d) What are the main characteristics of oligopoly?

e) What are some examples of barriers to entry?

f) What is the distinguishing characteristic of monopoly?
### Activity 1
#### Productivity Data

<table>
<thead>
<tr>
<th></th>
<th>Sample</th>
<th>Round 1</th>
<th>Round 2</th>
<th>Round 3</th>
<th>Round 4</th>
<th>Round 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Production method</td>
<td>Pizza-makers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Number of pizzas produced</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Number of pizzas accepted</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Cost of materials ($0.25 per pizza)</td>
<td>$1.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Number of workers</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Wages ($1.00 per worker)</td>
<td>$4.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. $2.00 rent for factory (desks)</td>
<td>$2.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Investment in capital goods ($0.25 per marker, $1.00 for scissors)</td>
<td>$1.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Total costs</td>
<td>$9.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Cost per pizza (average cost): Total cost (Line 9) + accepted pizzas produced (Line 3)</td>
<td>$9.00/4 = $2.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Total time worked: 3 minutes × number of workers (Line 5)</td>
<td>12 min.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Output per minute worked: number of pizzas (Line 3) + total time worked (Line 11)</td>
<td>4/12 = 0.333</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VISUAL 1
Output per Hour, Nonfarm Business Sector, 1972-2000
(1992=100)

The vertical axis uses a scale that shows equal percentage changes in output per hour as equal distances.

The Firm’s Goal
- To maximize profit

Accounting Cost and Profit
- An accountant measures cost and profit to ensure that the firm pays the correct amount of income tax and to show the bank how the firm has used its bank loan.
- Economists predict the decisions that a firm makes to maximize its profit. These decisions respond to opportunity cost and economic profit.
Opportunity Cost

- The highest-valued alternative forgone is the opportunity cost of a firm’s production.
- This opportunity cost is the amount that the firm must pay the owners of the factors of production it employs to attract them from their best alternative use.
- So a firm’s opportunity cost of production is the cost of the factors of production it employs.
Explicit Costs and Implicit Costs

An **explicit cost** is a cost paid in money.

An **implicit cost** is an opportunity cost incurred by a firm when it uses a factor of production for which it does not make a direct money payment.

The two main implicit costs are economic depreciation and the cost of using the firm owner’s resources.
ECONOMIC COST AND PROFIT

- **Economic depreciation** is an opportunity cost of a firm using capital that it owns—measured as the change in the *market* value of capital over a given period.

- **Normal profit** is the return to entrepreneurship.

- Normal profit is part of a firm’s opportunity cost because it is the cost of the entrepreneur not running another firm.
ECONOMIC COST AND PROFIT

Economic Profit

- A firm’s economic profit equals total revenue minus total cost.
- Total cost is the sum of the explicit costs and implicit costs and is the opportunity cost of production.
- Because the firm’s implicit costs is normal profit, the return to the entrepreneur equals normal profit plus economic profit.
- If a firm incurs an economic loss, the entrepreneur receives less than normal profit.
# Economic Cost and Profit

## Economic Accounting

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Revenue</strong></td>
<td>$150,000</td>
</tr>
<tr>
<td><strong>Explicit Costs</strong></td>
<td></td>
</tr>
<tr>
<td>Cost of fruit, yogurt, and honey</td>
<td>$20,000</td>
</tr>
<tr>
<td>Wages</td>
<td>$22,000</td>
</tr>
<tr>
<td>Interest</td>
<td>$3,000</td>
</tr>
<tr>
<td><strong>Implicit Costs</strong></td>
<td></td>
</tr>
<tr>
<td>Samantha’s forgone wages</td>
<td>$34,000</td>
</tr>
<tr>
<td>Samantha’s forgone interest</td>
<td>$1,000</td>
</tr>
<tr>
<td>Economic depreciation</td>
<td>$4,000</td>
</tr>
<tr>
<td>Normal profit</td>
<td>$16,000</td>
</tr>
<tr>
<td><strong>Opportunity Cost</strong></td>
<td>$100,000</td>
</tr>
<tr>
<td><strong>Economic Profit</strong></td>
<td>$50,000</td>
</tr>
</tbody>
</table>
Figure 14.1 shows two views of cost and profit.

Total revenue equals price multiplied by quantity sold.

Economists measure economic profit as total revenue minus opportunity cost.
Opportunity cost is the sum of Explicit costs and Implicit cost (including normal profit).
Accountants measure cost as the sum of explicit costs and accounting depreciation.

Accounting profit is total revenue minus accounting costs.
SHORT RUN AND LONG RUN

The Short Run: Fixed Plant

- The **short run** is a time frame in which the quantities of some resources are fixed.
- In the short run, a firm can usually change the quantity of labor it uses but not the quantity of capital.

The Long Run: Variable Plant

- The **long run** is a time frame in which the quantities of all resources can be changed.
- A sunk cost is irrelevant to the firm’s decisions.
To increase output with a fixed plant, a firm must increase the quantity of labor it uses.

We describe the relationship between output and the quantity of labor by using three related concepts:

- Total product
- Marginal product
- Average product
Total Product

- **Total product** \((TP)\) is the total quantity of a good produced in a given period.

- Total product is an output *rate*—the number of units produced per unit of time.

- Total product increases as the quantity of labor employed increases.
Figure 14.2 shows the total product and the total product curve.

Points A through H on the curve correspond to the columns of the table.

The TP curve is like the PPF: It separates attainable points and unattainable points.
Marginal Product

- **Marginal product** is the change in total product that results from a one-unit increase in the quantity of labor employed.

- Marginal product tells us the contribution to total product of adding one more worker.

- When the quantity of labor increases by more (or less) than one worker, calculate marginal product as:

  \[
  \text{Marginal product} = \frac{\text{Change in total product}}{\text{Change in quantity of labor}}
  \]
Figure 14.3 shows total product and marginal product.

We can illustrate marginal product as the orange bars that form steps along the total product curve.

The height of each step represents marginal product.
The table calculates marginal product and the orange bars in part (b) illustrate it.

Notice that the steeper the slope of the $TP$ curve, the greater is marginal product.
The total product and marginal product curves in this figure incorporate a feature of all production processes:

- Increasing marginal returns initially
- Decreasing marginal returns eventually
- Negative marginal returns

**SHORT-RUN PRODUCTION**
Increasing Marginal Returns

- **Increasing marginal returns** occur when the marginal product of an additional worker exceeds the marginal product of the previous worker.

- Increasing marginal returns occur when a small number of workers are employed and arise from increased specialization and division of labor in the production process.
Decreasing Marginal Returns

- **Decreasing marginal returns** occur when the marginal product of an additional worker is less than the marginal product of the previous worker.

- Decreasing marginal returns arise from the fact that more and more workers use the same equipment and work space.

- As more workers are employed, there is less and less that is productive for the additional worker to do.
SHORT-RUN PRODUCTION

- Decreasing marginal returns are so pervasive that they qualify for the status of a law:

- The **law of decreasing returns** states that:
  
  As a firm uses more of a variable input, with a given quantity of fixed inputs, the marginal product of the variable input eventually decreases.
Average Product

- **Average product** is the total product per worker employed.

- It is calculated as:

  \[
  \text{Average product} = \frac{\text{Total product}}{\text{Quantity of labor}}
  \]

- Another name for average product is productivity.
Figure 14.4 shows average product and its relationship to marginal product.

The table calculates average product.

For example, 3 workers produce a total product of 6 gallons per hour, so average product is $6 \div 3 = 2$ gallons per worker.
The figure graphs the average product against the quantity of labor employed.

The average product curve is $AP$.

When marginal product exceeds average product, average product is increasing.
When marginal product is less than average product, average product is decreasing.

When marginal product equals average product, average product is at its maximum.
Figure 25.2
The Law of Diminishing Marginal Returns
Figure 25.3
Marginal and Average Product

[Graph showing the relationship between quantity of labor and average product, marginal product, with points marked at specific quantities and product values.]
SHORT-RUN COST

- To produce more output in the short run, a firm employs more labor, which means the firm must increase its costs.

- We describe the relationship between output and cost using three cost concepts:
  - Total cost
  - Marginal cost
  - Average cost
SHORT-RUN COST

Total Cost

- A firm’s **total cost** ($TC$) is the cost of all the factors of production the firm uses.

- Total cost divides into two parts:
  - **Total fixed cost** ($TFC$) is the cost of a firm’s fixed factors of production used by a firm—the cost of land, capital, and entrepreneurship.
  - Total fixed cost doesn’t change as output changes.
SHORT-RUN COST

- **Total variable cost** ($TVC$) is the cost of the variable factor of production used by a firm—the cost of labor.

- To change its output in the short run, a firm must change the quantity of labor it employs, so total variable cost changes as output changes.

- Total cost is the sum of total fixed cost and total variable cost. That is,

  $$TC = TFC + TVC$$

- Table 14.2 on the next slide shows Sam’s Smoothies’ costs.
# SHORT-RUN COST

## Sam's Smoothies' Total Costs

<table>
<thead>
<tr>
<th>Labor  (workers per hour)</th>
<th>Output (gallons per hour)</th>
<th>Total fixed cost</th>
<th>Total variable cost (dollars per hour)</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>10.00</td>
</tr>
<tr>
<td>1.00</td>
<td>1</td>
<td>10</td>
<td>6.00</td>
<td>16.00</td>
</tr>
<tr>
<td>1.60</td>
<td>2</td>
<td>10</td>
<td>9.60</td>
<td>19.60</td>
</tr>
<tr>
<td>2.00</td>
<td>3</td>
<td>10</td>
<td>12.00</td>
<td>22.00</td>
</tr>
<tr>
<td>2.35</td>
<td>4</td>
<td>10</td>
<td>14.10</td>
<td>24.10</td>
</tr>
<tr>
<td>2.65</td>
<td>5</td>
<td>10</td>
<td>15.90</td>
<td>25.90</td>
</tr>
<tr>
<td>3.00</td>
<td>6</td>
<td>10</td>
<td>18.00</td>
<td>28.00</td>
</tr>
<tr>
<td>3.40</td>
<td>7</td>
<td>10</td>
<td>20.40</td>
<td>30.40</td>
</tr>
<tr>
<td>4.00</td>
<td>8</td>
<td>10</td>
<td>24.00</td>
<td>34.00</td>
</tr>
<tr>
<td>5.00</td>
<td>9</td>
<td>10</td>
<td>30.00</td>
<td>40.00</td>
</tr>
</tbody>
</table>
SHORT-RUN COST

Figure 14.5 shows Sam’s Smoothies’ total cost curves.

Total fixed cost \((TFC)\) is constant—it graphs as a horizontal line.

Total variable cost \((TVC)\) increases as output increases.

Total cost \((TC)\) also increases as output increases.
The vertical distance between the total cost curve and the total variable cost curve is total fixed cost, as illustrated by the two arrows.
SHORT-RUN COST

Marginal Cost

- A firm’s marginal cost is the change in total cost that results from a one-unit increase in total product.
- Marginal cost tells us how total cost changes as total product changes.
- Table 14.3 on the next slide calculates marginal cost for Sam’s Smoothies.
### Sam’s Smoothies’ Marginal Cost

<table>
<thead>
<tr>
<th>Output (gallons per hour)</th>
<th>Total cost (dollars per hour)</th>
<th>Marginal cost (dollars per gallon)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10.00</td>
<td>6.00</td>
</tr>
<tr>
<td>1</td>
<td>16.00</td>
<td>3.60</td>
</tr>
<tr>
<td>2</td>
<td>19.60</td>
<td>3.60</td>
</tr>
<tr>
<td>3</td>
<td>22.00</td>
<td>2.40</td>
</tr>
<tr>
<td>4</td>
<td>24.10</td>
<td>2.10</td>
</tr>
<tr>
<td>5</td>
<td>25.90</td>
<td>1.80</td>
</tr>
<tr>
<td>6</td>
<td>28.00</td>
<td>2.10</td>
</tr>
<tr>
<td>7</td>
<td>30.40</td>
<td>2.40</td>
</tr>
<tr>
<td>8</td>
<td>34.00</td>
<td>3.60</td>
</tr>
<tr>
<td>9</td>
<td>40.00</td>
<td>6.00</td>
</tr>
</tbody>
</table>
There are three average cost concepts:

- **Average fixed cost** \((AFC)\) is total fixed cost per unit of output.
- **Average variable cost** \((AVC)\) is total variable cost per unit of output.
- **Average total cost** \((ATC)\) is total cost per unit of output.
The average cost concepts are calculated from the total cost concepts as follows:

\[ TC = TFC + TVC \]

Divide each total cost term by the quantity produced, \( Q \), to give

\[
\frac{TC}{Q} = \frac{TFC}{Q} + \frac{TVC}{Q}
\]

or,

\[ ATC = AFC + AVC \]
<table>
<thead>
<tr>
<th>Output (gallons per hour)</th>
<th>Total cost (dollars per hour)</th>
<th>Marginal cost (dollars per gallon)</th>
<th>Average fixed cost (dollars per gallon)</th>
<th>Average variable cost (dollars per gallon)</th>
<th>Average total cost (dollars per gallon)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10.00</td>
<td>6.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>16.00</td>
<td>3.60</td>
<td>10.00</td>
<td>6.00</td>
<td>16.00</td>
</tr>
<tr>
<td>2</td>
<td>19.60</td>
<td>2.40</td>
<td>5.00</td>
<td>4.80</td>
<td>9.80</td>
</tr>
<tr>
<td>3</td>
<td>22.00</td>
<td>2.10</td>
<td>3.33</td>
<td>4.00</td>
<td>7.33</td>
</tr>
<tr>
<td>4</td>
<td>24.10</td>
<td>1.80</td>
<td>2.50</td>
<td>3.53</td>
<td>6.03</td>
</tr>
<tr>
<td>5</td>
<td>25.90</td>
<td>2.10</td>
<td>2.00</td>
<td>3.18</td>
<td>5.18</td>
</tr>
<tr>
<td>6</td>
<td>28.00</td>
<td>2.40</td>
<td>1.67</td>
<td>3.00</td>
<td>4.67</td>
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<tr>
<td>7</td>
<td>30.40</td>
<td>3.60</td>
<td>1.43</td>
<td>2.91</td>
<td>4.34</td>
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<tr>
<td>8</td>
<td>34.00</td>
<td>6.00</td>
<td>1.25</td>
<td>3.00</td>
<td>4.25</td>
</tr>
<tr>
<td>9</td>
<td>40.00</td>
<td></td>
<td>1.11</td>
<td>3.33</td>
<td>4.44</td>
</tr>
</tbody>
</table>
Figure 14.6 shows the average cost curves and marginal cost curve at Sam’s Smoothies.

Average fixed cost (AFC) decreases as output increases.

The average variable cost curve (AVC) is U-shaped.

The average total cost curve (ATC) is also U-shaped.
The marginal cost curve \((MC)\) is U-shaped and intersects the average variable cost curve \((AVC)\) and the average total cost curve \((ATC)\) at their minimum points.

The vertical distance between \(ATC\) and \(AVC\) curves is equal to \(AFC\), as illustrated by the two arrows.

\[
ATC = AFC + AVC
\]
Why the Average Total Cost Curve Is U-Shaped

- Average total cost, $ATC$, is the sum of average fixed cost, $AFC$, and average variable cost, $AVC$.

- The shape of the $ATC$ curve combines the shapes of the $AFC$ and $AVC$ curves.

- The U shape of the average total cost curve arises from the influence of two opposing forces:
  - Spreading total fixed cost over a larger output
  - Decreasing marginal returns
## SHORT-RUN COST

A Compact Glossary of Costs

<table>
<thead>
<tr>
<th>Term</th>
<th>Symbol</th>
<th>Definition</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed cost</td>
<td></td>
<td>The cost of a fixed factor of production that is independent of the quantity produced</td>
<td></td>
</tr>
<tr>
<td>Variable cost</td>
<td></td>
<td>The cost of a variable factor of production that varies with the quantity produced</td>
<td></td>
</tr>
<tr>
<td>Total fixed cost</td>
<td>$TFC$</td>
<td>Cost of the fixed factors of production</td>
<td></td>
</tr>
<tr>
<td>Total variable cost</td>
<td>$TVC$</td>
<td>Cost of the variable factor of production</td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td>$TC$</td>
<td>Cost of all factors of production</td>
<td>$TC = TFC + TVC$</td>
</tr>
<tr>
<td>Marginal cost</td>
<td>$MC$</td>
<td>Change in total cost resulting from a one-unit increase in output ($Q$)</td>
<td>$MC = \Delta TC / \Delta Q^*$</td>
</tr>
<tr>
<td>Average fixed cost</td>
<td>$AFC$</td>
<td>Total fixed cost per unit of output</td>
<td>$AFC = TFC / Q$</td>
</tr>
<tr>
<td>Average variable cost</td>
<td>$AVC$</td>
<td>Total variable cost per unit of output</td>
<td>$AVC = TVC / Q$</td>
</tr>
<tr>
<td>Average total cost</td>
<td>$ATC$</td>
<td>Total cost per unit of output</td>
<td>$ATC = AFC + AVC$</td>
</tr>
</tbody>
</table>
SHORT-RUN COST

Cost Curves and Product Curves

- The technology that a firm uses determines its costs.

- At low levels of employment and output, as the firm hires more labor, marginal product and average product rise, and marginal cost and average variable cost fall.

- Then, at the point of maximum marginal product, marginal cost is a minimum.

- As the firm hires more labor, marginal product decreases and marginal cost increases.
SHORT-RUN COST

- But average product continues to rise, and average variable cost continues to fall.

- Then, at the point of maximum average product, average variable cost is a minimum.

- As the firm hires even more labor, average product decreases and average variable cost increases.
Figure 14.7 illustrates the relationship between the product curves and cost curves.

A firm’s marginal cost curve is linked to its marginal product curve.

If marginal product rises, marginal cost falls.

If marginal product is a maximum, marginal cost is a minimum.
SHORT-RUN COST

- But average product continues to rise, and average variable cost continues to fall.
- Then, at the point of maximum average product, average variable cost is a minimum.
- As the firm hires even more labor, average product decreases and average variable cost increases.
A firm’s average variable cost curve is linked to its average product curve.

If average product rises, average variable cost falls.

If average product is a maximum, average variable cost is a minimum.
At small outputs, \( MP \) and \( AP \) rise and \( MC \) and \( AVC \) fall.

At intermediate outputs, \( MP \) falls and \( MC \) rises and \( AP \) rises and \( AVC \) falls.

At large outputs, \( MP \) and \( AP \) fall and \( MC \) and \( AVC \) rise.
Shifts in Cost Curves

Technology

- A technological change that increases productivity shifts the $TP$ curve upward. It also shifts the $MP$ curve and the $AP$ curve upward.

- With a better technology, the same inputs can produce more output, so an advance in technology lowers the average and marginal costs and shifts the short-run cost curves downward.
SHORT-RUN COST

Prices of Factors of Production

- An increase in the price of a factor of production increases costs and shifts the cost curves.
- But how the curves shift depends on which resource price changes.
- An increase in rent or another component of fixed cost
  - Shifts the fixed cost curves ($TFC$ and $AFC$) upward.
  - Shifts the total cost curve ($TC$) upward.
  - Leaves the variable cost curves ($AVC$ and $TVC$) and the marginal cost curve ($MC$) unchanged.
SHORT-RUN COST

- An increase in the wage rate or another component of variable cost
  - Shifts the variable curves ($TVC$ and $AVC$) upward.
  - Shifts the marginal cost curve ($MC$) upward.
  - Leaves the fixed cost curves ($AFC$ and $TFC$) unchanged.
Figure 26.2
Graph of Aggregate Cost Data

Aggregate and Unit Cost Structure

<table>
<thead>
<tr>
<th>Output</th>
<th>Total Fixed Cost</th>
<th>Total Variable Cost</th>
<th>Total Cost</th>
<th>Marginal Cost (ATC / ∆Q)</th>
<th>Average Fixed Cost</th>
<th>Average Variable Cost</th>
<th>Average Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>$0</td>
<td>$500</td>
<td>$7.00</td>
<td>$5.00</td>
<td>$7.00</td>
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<td>6.00</td>
<td>2.50</td>
<td>6.50</td>
<td>9.00</td>
</tr>
<tr>
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<td>1,300</td>
<td>2,800</td>
<td>5.00</td>
<td>1.67</td>
<td>6.00</td>
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<td>6.00</td>
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<td>6.00</td>
<td>7.25</td>
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<tr>
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<td>3,900</td>
<td>7.00</td>
<td>1.00</td>
<td>8.20</td>
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<tr>
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<td>5,200</td>
<td>9.60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 26.3
Graph of Unit Cost Data

Note: Marginal cost ($TC / ΔQ$) is plotted between the output levels shown in Figure 26.1.
When a firm changes its plant size, its cost of producing a given output changes.

Will the average total cost of producing a gallon of smoothie fall, rise, or remain the same?

Each of these three outcomes arise because when a firm changes the size of its plant, it might experience:

- Economies of scale
- Diseconomies of scale
- Constant returns to scale
Economies of Scale

- **Economies of scale** exist if when a firm increases its plant size and labor employed by the same percentage, its output increases by a larger percentage and average total cost decreases.

- The main source of economies of scale is greater specialization of both labor and capital.
Diseconomies of Scale

- **Diseconomies of scale** exist if when a firm increases its plant size and labor employed by the same percentage, its output increases by a smaller percentage and average total cost increases.

- Diseconomies of scale arise from the difficulty of coordinating and controlling a large enterprise.

- Eventually, management complexity brings rising average total cost.
LONG-RUN COST

Constant Returns to Scale

- **Constant returns to scale** exist if when a firm increases its plant size and labor employed by the same percentage, its output increases by the same percentage and average total cost remains constant.

- Constant returns to scale occur when a firm is able to replicate its existing production facility including its management system.
LONG-RUN COST

The Long-Run Average Cost Curve

- **Long-run average cost curve** shows the lowest average cost at which it is possible to produce each output when the firm has had sufficient time to change both its plant size and labor employed.
LONG-RUN COST

Figure 14.8 shows a long-run average cost curve.

In the long run, Sam’s Smoothies can vary both capital and labor inputs.

With its current plant, Sam’s ATC curve is \( ATC_1 \).

With successively larger plants, Sam’s ATC curves would be \( ATC_2 \), \( ATC_3 \), and \( ATC_4 \).
The long-run average cost curve, $LRAC$, traces the lowest attainable average total cost of producing each output.
Sam’s experiences economies of scale as output increases to 14 gallons an hour, ...

constant returns to scale for outputs between 14 gallons and 19 gallons an hour, ...

and diseconomies of scale for outputs that exceed 19 gallons an hour.
Wal-Mart’s “small” supercenters measure 99,000 square feet and serve an average of 30,000 customers a week.

The average 7–Eleven store, mostly attached to gas stations, measures 2,000 square feet and serves 5,000 customers a week.

Which retailing technology has the lower operating cost?

The answer depends on the scale of operation.

At a small number of customers per week, it costs less per customer to operate a store of 2,000 square feet than a store of 99,000 square feet.
Which Store Has the Lower Costs: Wal-Mart or 7–Eleven?

The $ATC$ curve of a store of 2,000 square feet is $ATC_{7\text{-Eleven}}$. The $ATC$ curve of a store of 99,000 square feet is $ATC_{Wal-Mart}$.
Which Store Has the Lower Costs: Wal-Mart or 7–Eleven?

The dark blue curve is a retailer’s LRAC curve.

With $Q$ customers a week, the average total cost of a transaction is the same in both stores.
Which Store Has the Lower Costs: Wal-Mart or 7–Eleven?

For a store that serves more than $Q$ customers a week, the least-cost method is the big store.

For a store that serves fewer than $Q$ customers a week, the least-cost method is the small store.