Firm behavior and the organization of industry

What are Costs?
• Total revenue, TR = P × Q
  – Amount a firm receives for the sale of its output
  – Quantity of output the firm produces times the price at which it sells its output
• Total cost, TC
  – Market value of the inputs a firm uses in production

What are Costs?
• Costs as opportunity costs
  – The cost of something is what you give up to get it
• Firm’s cost of production
  – Include all the opportunity costs of making its output of goods and services
    – Explicit costs
    – Implicit costs
What are Costs?

- **Explicit costs**
  - Input costs that require an outlay of money by the firm

- **Implicit costs**
  - Input costs that do not require an outlay of money by the firm
  - Ignored by accountants

- **Total costs**
  - $= \text{Explicit costs} + \text{Implicit costs}$

What are Costs?

- **The cost of financial capital as an opportunity cost**
  - Implicit cost
  - Interest income not earned on financial capital
    - Owned as saving
    - Invested in business
  - Not shown as cost by an accountant

What are Costs?

- **Economic profit**
  - Total revenue minus total cost
    - Total costs includes both explicit and implicit costs

- **Accounting profit**
  - Total revenue minus total explicit cost
    - Usually larger than economic profit
Economists versus Accountants

Economists include all opportunity costs when analyzing a firm, whereas accountants measure only explicit costs. Therefore, economic profit is smaller than accounting profit.

Production and Costs

• Production function
  – Relationship between
    • Quantity of inputs used to make a good
    • And the quantity of output of that good
  – Gets flatter as production rises

Table 1
A Production Function and Total Cost: Caroline’s Cookie Factory

<table>
<thead>
<tr>
<th>Number of Workers</th>
<th>Output (quantity of cookies produced per hour)</th>
<th>Marginal Product of Labor</th>
<th>Cost of Factory</th>
<th>Cost of Workers</th>
<th>Total Cost of Inputs (cost of factory + cost of workers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td></td>
<td>$30</td>
<td>$0</td>
<td>$30</td>
</tr>
<tr>
<td>1</td>
<td>50</td>
<td>40</td>
<td>30</td>
<td>10</td>
<td>40</td>
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<tr>
<td>2</td>
<td>90</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>120</td>
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<td>60</td>
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<td>4</td>
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<td>40</td>
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<td>150</td>
<td>5</td>
<td>30</td>
<td>50</td>
<td>80</td>
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<tr>
<td>6</td>
<td>155</td>
<td>5</td>
<td>30</td>
<td>60</td>
<td>90</td>
</tr>
</tbody>
</table>
Production and Costs

• **Diminishing marginal product**
  – Marginal product of an input declines as the quantity of the input increases
  – Production function gets flatter as more inputs are being used

• **Total-cost curve**
  – Relationship between quantity produced and total costs
  – Gets steeper as the amount produced rises
  • Diminishing marginal product
  • Producing one additional unit of output requires a lot of additional units of inputs
    – Very costly

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Caroline’s Production Function and Total-Cost Curve

The production function in panel (a) shows the relationship between the number of workers hired and the quantity of output produced. Here the number of workers hired (on the horizontal axis) is from the first column in Table 1, and the quantity of output produced (on the vertical axis) is from the second column. The production function gets flatter as the number of workers increases, reflecting diminishing marginal product. The total-cost curve in panel (b) shows the relationship between the quantity of output produced and total cost of production. Here the quantity of output produced (on the horizontal axis) is from the second column in Table 1, and the total cost (on the vertical axis) is from the sixth column. The total-cost curve gets steeper as the quantity of output increases because of diminishing marginal product.
The Various Measures of Cost

• **Fixed costs**  
  – Costs that do not vary with the quantity of output produced

• **Variable costs**  
  – Costs that vary with the quantity of output produced

• **Total cost**  
  \[ \text{Total cost} = \text{Fixed cost} + \text{Variable cost} \]

The Various Measures of Cost

• **Average fixed cost, AFC**  
  – Fixed cost divided by the quantity of output

• **Average variable cost, AVC**  
  – Variable cost divided by the quantity of output

The Various Measures of Cost

• **Average total cost, ATC**  
  – Total cost divided by the quantity of output
  – Average total cost = \( \frac{\text{Total cost}}{\text{Quantity}} \)
  – \( \text{ATC} = \frac{\text{TC}}{Q} \)
  – Cost of a typical unit of output   
    • If total cost is divided evenly over all the units produced

The Various Measures of Cost

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  – Cost of a typical unit of output   
    • If total cost is divided evenly over all the units produced
The Various Measures of Cost

- Marginal cost, MC
  - Increase in total cost arising from an extra unit of production
  - Marginal cost = Change in total cost / Change in quantity
  - \( MC = \frac{\Delta TC}{\Delta Q} \)
  - Increase in total cost
    - From producing an additional unit of output

### Table 2: The Various Measures of Cost: Conrad’s Coffee Shop

<table>
<thead>
<tr>
<th>Output (cups of coffee per hour)</th>
<th>Total Cost</th>
<th>Fixed Cost</th>
<th>Variable Cost</th>
<th>Average Fixed Cost</th>
<th>Average Variable Cost</th>
<th>Average Total Cost</th>
<th>Marginal Cost</th>
</tr>
</thead>
<tbody>
<tr>
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<td>$3.00</td>
<td>$3.00</td>
<td>$0.00</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>$10.00</td>
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<tr>
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<tr>
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<td>0.40</td>
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<td>3.00</td>
<td>1.50</td>
<td>1.50</td>
<td>0.50</td>
<td>1.50</td>
<td>0.70</td>
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<tr>
<td>4</td>
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<td>0.95</td>
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<tr>
<td>5</td>
<td>6.50</td>
<td>3.00</td>
<td>3.50</td>
<td>0.60</td>
<td>0.70</td>
<td>1.30</td>
<td>1.10</td>
</tr>
<tr>
<td>6</td>
<td>7.80</td>
<td>3.00</td>
<td>4.80</td>
<td>0.50</td>
<td>0.80</td>
<td>1.30</td>
<td>1.30</td>
</tr>
<tr>
<td>7</td>
<td>9.30</td>
<td>3.00</td>
<td>6.30</td>
<td>0.43</td>
<td>0.90</td>
<td>1.83</td>
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<tr>
<td>8</td>
<td>11.00</td>
<td>3.00</td>
<td>8.00</td>
<td>0.58</td>
<td>1.00</td>
<td>1.88</td>
<td>1.80</td>
</tr>
<tr>
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<td>12.90</td>
<td>3.00</td>
<td>9.90</td>
<td>0.33</td>
<td>1.10</td>
<td>1.43</td>
<td>1.60</td>
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<td>10</td>
<td>15.00</td>
<td>3.00</td>
<td>12.00</td>
<td>0.50</td>
<td>1.20</td>
<td>1.50</td>
<td>2.10</td>
</tr>
</tbody>
</table>

Conrad’s Total-Cost Curve

Here the quantity of output produced (on the horizontal axis) is from the first column in Table 2, and the total cost (on the vertical axis) is from the second column. As in Figure 2, the total-cost curve gets steeper as the quantity of output increases because of diminishing marginal product.
Conrad’s Average-Cost and Marginal-Cost Curves

This figure shows the average total cost (ATC), average fixed cost (AFC), average variable cost (AVC), and marginal cost (MC) for Conrad’s Coffee Shop. All of these curves are obtained by graphing the data in Table 2. These cost curves show three features that are typical of many firms: (1) Marginal cost rises with the quantity of output. (2) The average-total-cost curve is U-shaped. (3) The marginal-cost curve crosses the average-total-cost curve at the minimum of average total cost.

Cost Curves for a Typical Firm

Many firms experience increasing marginal product before diminishing marginal product. As a result, they have cost curves shaped like those in this figure. Notice that marginal cost and average variable cost fall for a while before starting to rise.

Costs in Short and Long Run

• Many decisions
  – Fixed in the short run
  – Variable in the long run

• Firms – greater flexibility in the long-run
  – Long-run cost curves
    • Differ from short-run cost curves
    • Much flatter than short-run cost curves
  – Short-run cost curves
    • Lie on or above the long-run cost curves
Because fixed costs are variable in the long run, the average-total-cost curve in the short run differs from the average-total-cost curve in the long run.

![Figure 6: Average Total Cost in the Short and Long Runs](image)

**Table 3: The Many Types of Cost: A Summary**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Mathematical Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explicit costs</td>
<td>Costs that require an outlay of money by the firm</td>
<td></td>
</tr>
<tr>
<td>Implicit costs</td>
<td>Costs that do not require an outlay of money by the firm</td>
<td></td>
</tr>
<tr>
<td>Fixed costs</td>
<td>Costs that do not vary with the quantity of output produced</td>
<td>FC</td>
</tr>
<tr>
<td>Variable costs</td>
<td>Costs that vary with the quantity of output produced</td>
<td>VC</td>
</tr>
<tr>
<td>Total cost</td>
<td>The market value of all the inputs that a firm uses in production</td>
<td>TC = FC + VC</td>
</tr>
<tr>
<td>Average fixed cost</td>
<td>Fixed cost divided by the quantity of output</td>
<td>AFC = FC/Q</td>
</tr>
<tr>
<td>Average variable cost</td>
<td>Variable cost divided by the quantity of output</td>
<td>AVC = VC/Q</td>
</tr>
<tr>
<td>Average total cost</td>
<td>Total cost divided by the quantity of output</td>
<td>ATC = TC/Q</td>
</tr>
<tr>
<td>Marginal cost</td>
<td>The increase in total cost that arises from an extra unit of production</td>
<td>MC = ΔTC/ΔQ</td>
</tr>
</tbody>
</table>