Production and Costs

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The Costs of Production

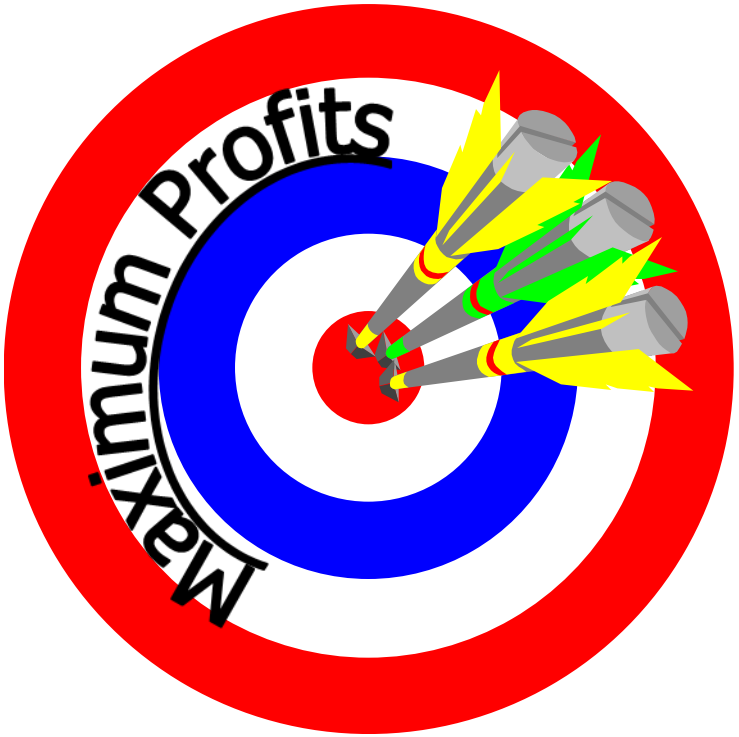
- The Market Forces of Supply and Demand
  - *Supply* and *demand* are the two words that economists use most often.
  - *Supply* and *demand* are the forces that make market economies work.
  - Modern microeconomics is about supply, demand, and market equilibrium.

WHAT ARE COSTS?

- According to the Law of Supply:
  - Firms are willing to produce and sell a greater quantity of a good when the price of the good is high.
  - This results in a supply curve that slopes upward.

WHAT ARE COSTS?

- The Firm's Objective
  - The economic goal of the firm is to maximize profits.



Total Revenue, Total Cost, and Profit

- *Total Revenue*
  - The amount a firm receives for the sale of its output.
- *Total Cost*
  - The market value of the inputs a firm uses in production.

Total Revenue, Total Cost, and Profit

- *Profit* is the firm's total revenue minus its total cost.

- Profit = Total revenue - Total cost

Costs as Opportunity Costs

- A firm's cost of production includes all the opportunity costs of making its output of goods and services.
- Explicit and Implicit Costs
  - A firm's cost of production include *explicit costs* and *implicit costs.*
    - Explicit costs are input costs that require a direct outlay of money by the firm.
    - Implicit costs are input costs that do not require an outlay of money by the firm.

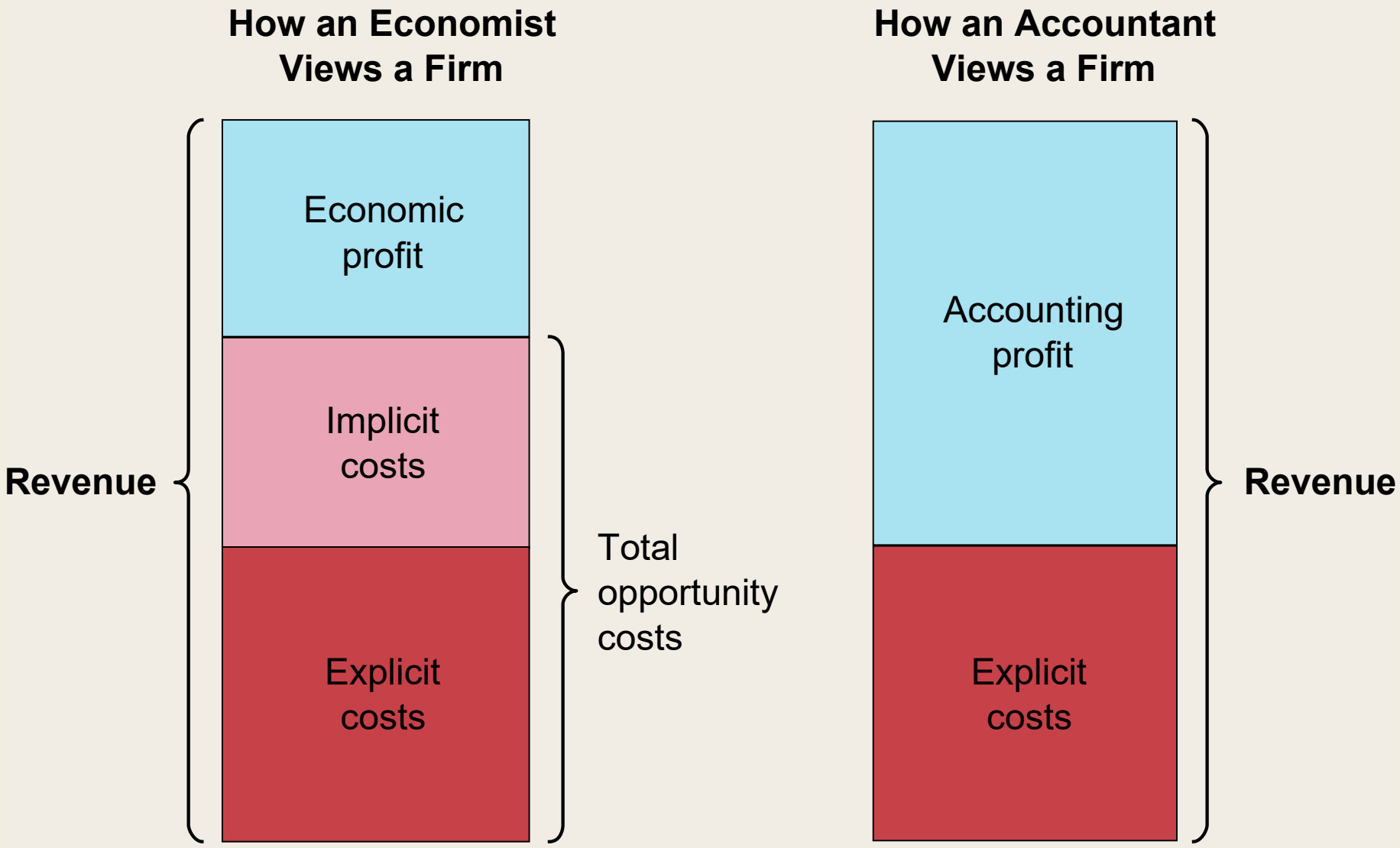
Economic Profit versus Accounting Profit

- Economists measure a firm's *economic profit* as total revenue minus total cost, including both explicit and implicit costs.
- Accountants measure the *accounting profit* as the firm's total revenue minus only the firm's explicit costs.

Economic Profit versus Accounting Profit

- When total revenue exceeds both explicit and implicit costs, the firm earns economic profit.
- Economic profit is smaller than accounting profit.

Figure 1 Economists versus Accountants



PRODUCTION AND COSTS

- The Production Function
  - The *production function* shows the relationship between quantity of inputs used to make a good and the quantity of output of that good.

The Production Function

- Marginal Product
  - The *marginal product* of any input in the production process is the increase in output that arises from an additional unit of that input.

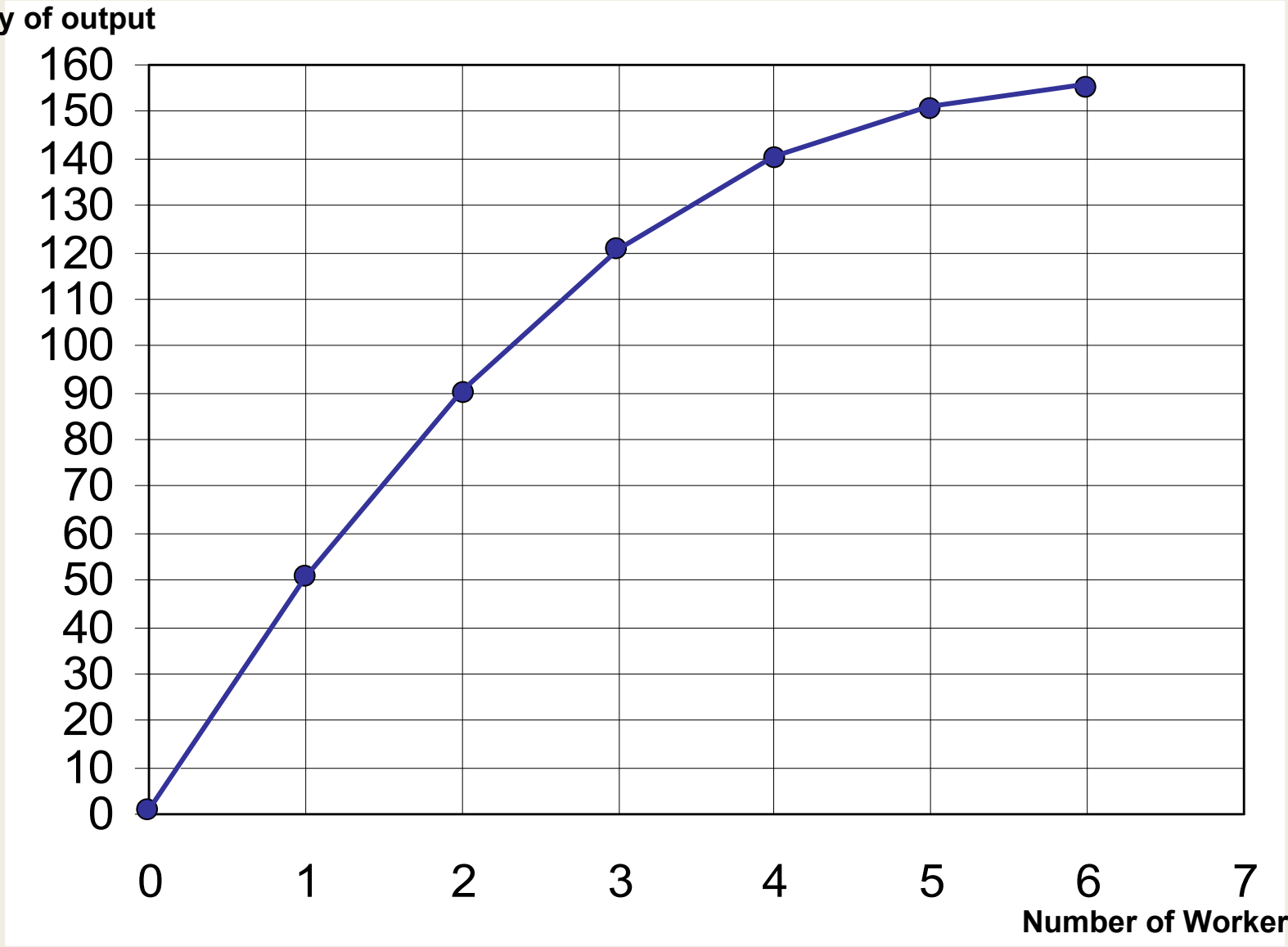
Table 1 A Production Function and Total Cost: Hungry Helen's Cookie Factory

Number of Workers	Output (quantity of cookies produced per hour)	Marginal Product of Labor	Cost of Factory	Cost of Workers	Total Cost of Inputs (cost of factory + cost of workers)
0	0		$30	$0	$30
		50			
1	50		30	10	40
		40			
2	90		30	20	50
		30			
3	120		30	30	60
		20			
4	140		30	40	70
		10			
5	150		30	50	80
		5			
6	155		30	60	90

The Production Function

- *Diminishing marginal product* is the property whereby the marginal product of an input declines as the quantity of the input increases.
  - Example: As more and more workers are hired at a firm, each additional worker contributes less and less to production because the firm has a limited amount of equipment.

Figure 2 Hungry Helen's Production Function



The Production Function

- Diminishing Marginal Product
  - The slope of the production function measures the marginal product of an input, such as a worker.
  - When the marginal product declines, the production function becomes flatter.

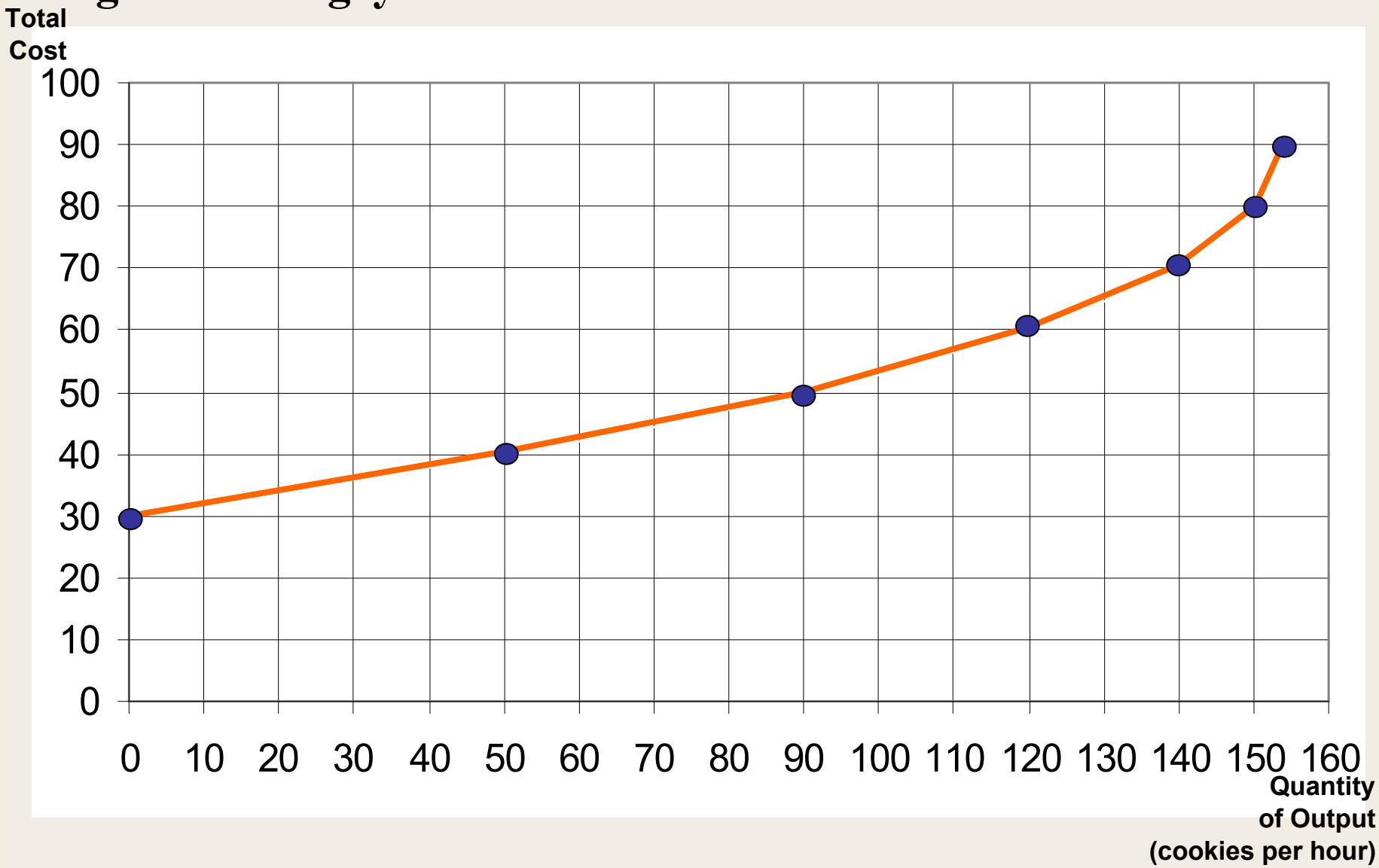
From the Production Function to the Total-Cost Curve

- The relationship between the quantity a firm can produce and its costs determines pricing decisions.
- The total-cost curve shows this relationship graphically.

Table 1 A Production Function and Total Cost: Hungry Helen's Cookie Factory

Number of Workers	Output (quantity of cookies produced per hour)	Marginal Product of Labor	Cost of Factory	Cost of Workers	Total Cost of Inputs (cost of factory + cost of workers)
0	0		$30	$0	$30
		50			
1	50		30	10	40
		40			
2	90		30	20	50
		30			
3	120		30	30	60
		20			
4	140		30	40	70
		10			
5	150		30	50	80
		5			
6	155		30	60	90

Figure 2 Hungry Helen's Total-Cost Curve



THE VARIOUS MEASURES OF COST

- Costs of production may be divided into *fixed costs* and *variable costs*.
  - **Fixed costs** are those costs that *do not vary* with the quantity of output produced.
  - **Variable costs** are those costs that *do vary* with the quantity of output produced.

Fixed and Variable Costs

- Total Costs
  - Total Fixed Costs (TFC)
  - Total Variable Costs (TVC)
  - Total Costs (TC)
  - $TC = TFC + TVC$

Table 2 The Various Measures of Cost: Thirsty Thelma's Lemonade Stand

Quantity of Lemonade (Glasses per hour)	Total Cost	Fixed Cost	Variable Cost	Average Fixed Cost	Average Variable Cost	Average Total Cost	Marginal Cost
0	$ 3.00	$3.00	$ 0.00	—	—	—	
							$0.30
1	3.30	3.00	0.30	$3.00	$0.30	$3.30	
							0.50
2	3.80	3.00	0.80	1.50	0.40	1.90	
							0.70
3	4.50	3.00	1.50	1.00	0.50	1.50	
							0.90
4	5.40	3.00	2.40	0.75	0.60	1.35	
							1.10
5	6.50	3.00	3.50	0.60	0.70	1.30	
							1.30
6	7.80	3.00	4.80	0.50	0.80	1.30	
							1.50
7	9.30	3.00	6.30	0.43	0.90	1.33	
							1.70
8	11.00	3.00	8.00	0.38	1.00	1.38	
							1.90
9	12.90	3.00	9.90	0.33	1.10	1.43	
							2.10
10	15.00	3.00	12.00	0.30	1.20	1.50	

Fixed and Variable Costs

- Average Costs
  - Average costs can be determined by dividing the firm's costs by the quantity of output it produces.
  - The average cost is the cost of each typical unit of product.

Fixed and Variable Costs

- Average Costs
  - *Average Fixed Costs* (AFC)
  - *Average Variable Costs* (AVC)
  - *Average Total Costs* (ATC)
  - $ATC = AFC + AVC$

Average and Marginal Costs

$$AFC = \frac{\text{Fixed cost}}{\text{Quantity}} = \frac{FC}{Q}$$

$$AVC = \frac{\text{Variable cost}}{\text{Quantity}} = \frac{VC}{Q}$$

$$ATC = \frac{\text{Total cost}}{\text{Quantity}} = \frac{TC}{Q}$$

Average and Marginal Costs

- Marginal Cost
  - *Marginal cost* (MC) measures the increase in total cost that arises from an extra unit of production.
  - Marginal cost helps answer the following question:
    - How much does it cost to produce an additional unit of output?

Average and Marginal Cost

$$MC = \frac{(\text{change in total cost})}{(\text{change in quantity})} = \frac{\Delta TC}{\Delta Q}$$

Thirsty Thelma's Lemonade Stand

Note how Marginal Cost changes with each change in Quantity.

Quantity	Total Cost	Marginal Cost	Quantity	Total Cost	Marginal Cost
0	$3.00	—			
1	3.30	$0.30	6	$7.80	$1.30
2	3.80	0.50	7	9.30	1.50
3	4.50	0.70	8	11.00	1.70
4	5.40	0.90	9	12.90	1.90
5	6.50	1.10	10	15.00	2.10

Figure 3 Thirsty Thelma's Total-Cost Curves

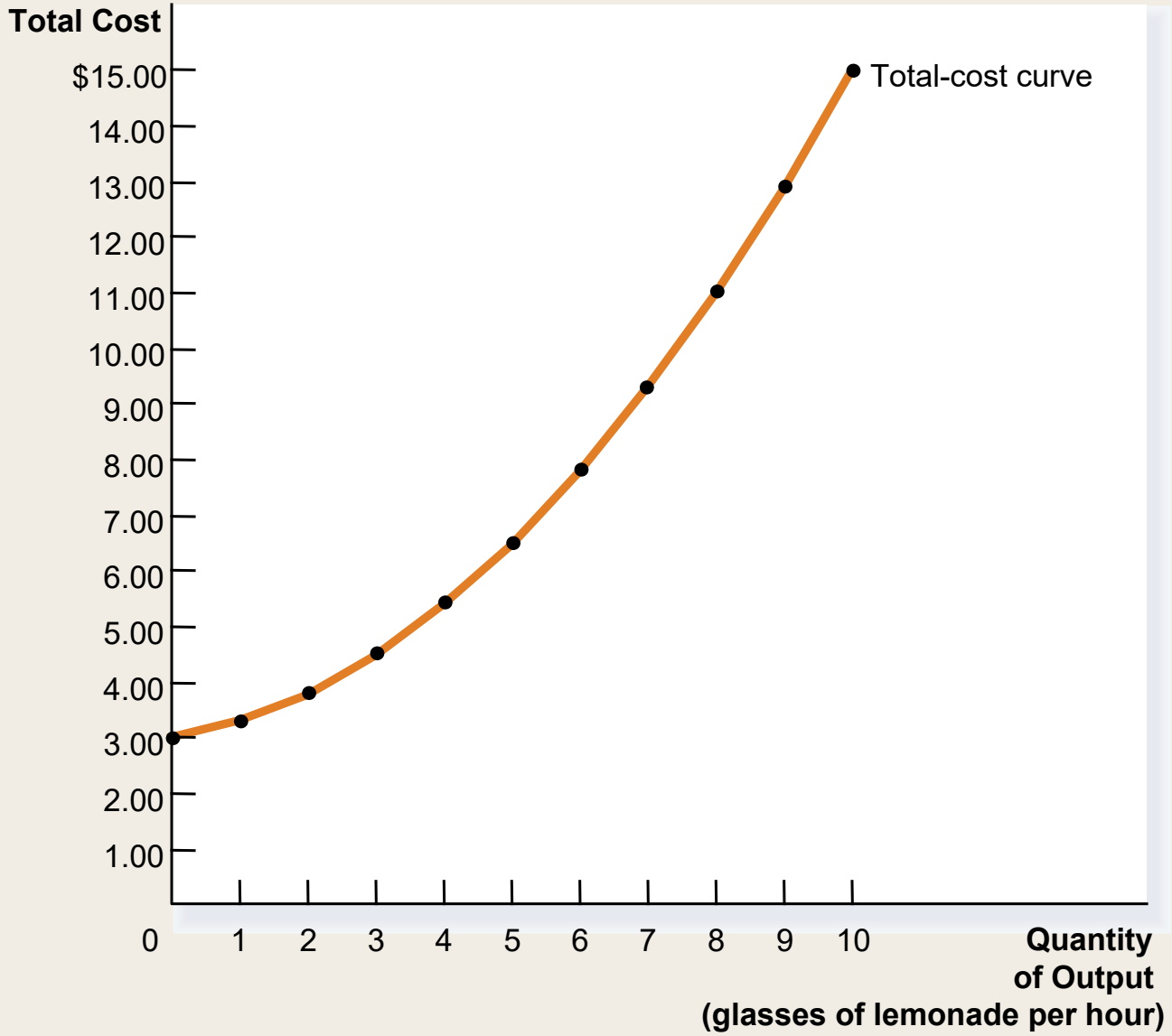
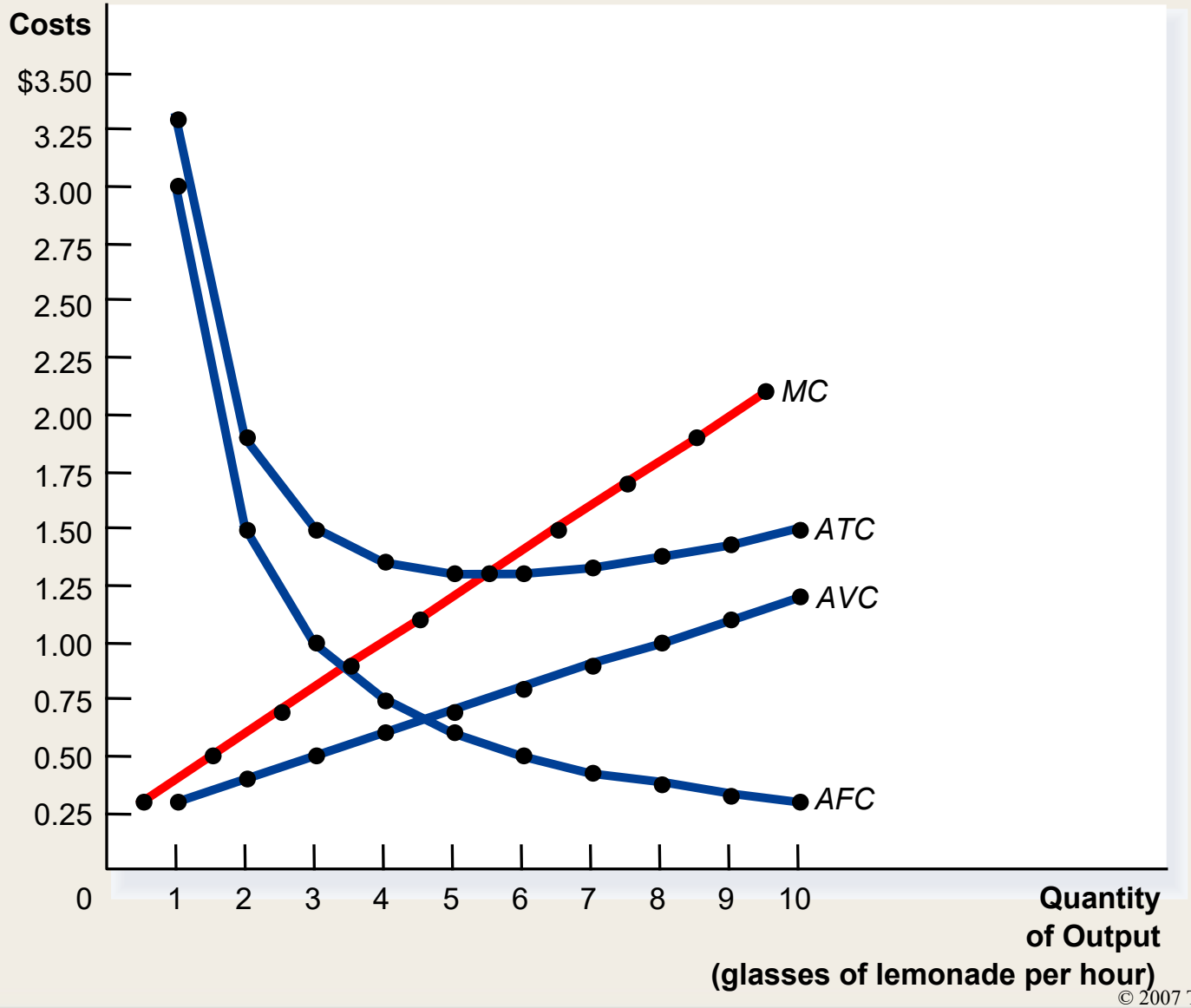


Figure 4 Thirsty Thelma's Average-Cost and Marginal-Cost Curves



Cost Curves and Their Shapes

- Marginal cost rises with the amount of output produced.
  - This reflects the property of diminishing marginal product.

Cost Curves and Their Shapes

- The average total-cost curve is U-shaped.
- At very low levels of output average total cost is high because fixed cost is spread over only a few units.
- Average total cost declines as output increases.
- Average total cost starts rising because average variable cost rises substantially.

Cost Curves and Their Shapes

- The bottom of the U-shaped ATC curve occurs at the quantity that minimizes average total cost. This quantity is sometimes called the efficient scale of the firm.

Cost Curves and Their Shapes

- Relationship between Marginal Cost and Average Total Cost
  - Whenever marginal cost is less than average total cost, average total cost is falling.
  - Whenever marginal cost is greater than average total cost, average total cost is rising.

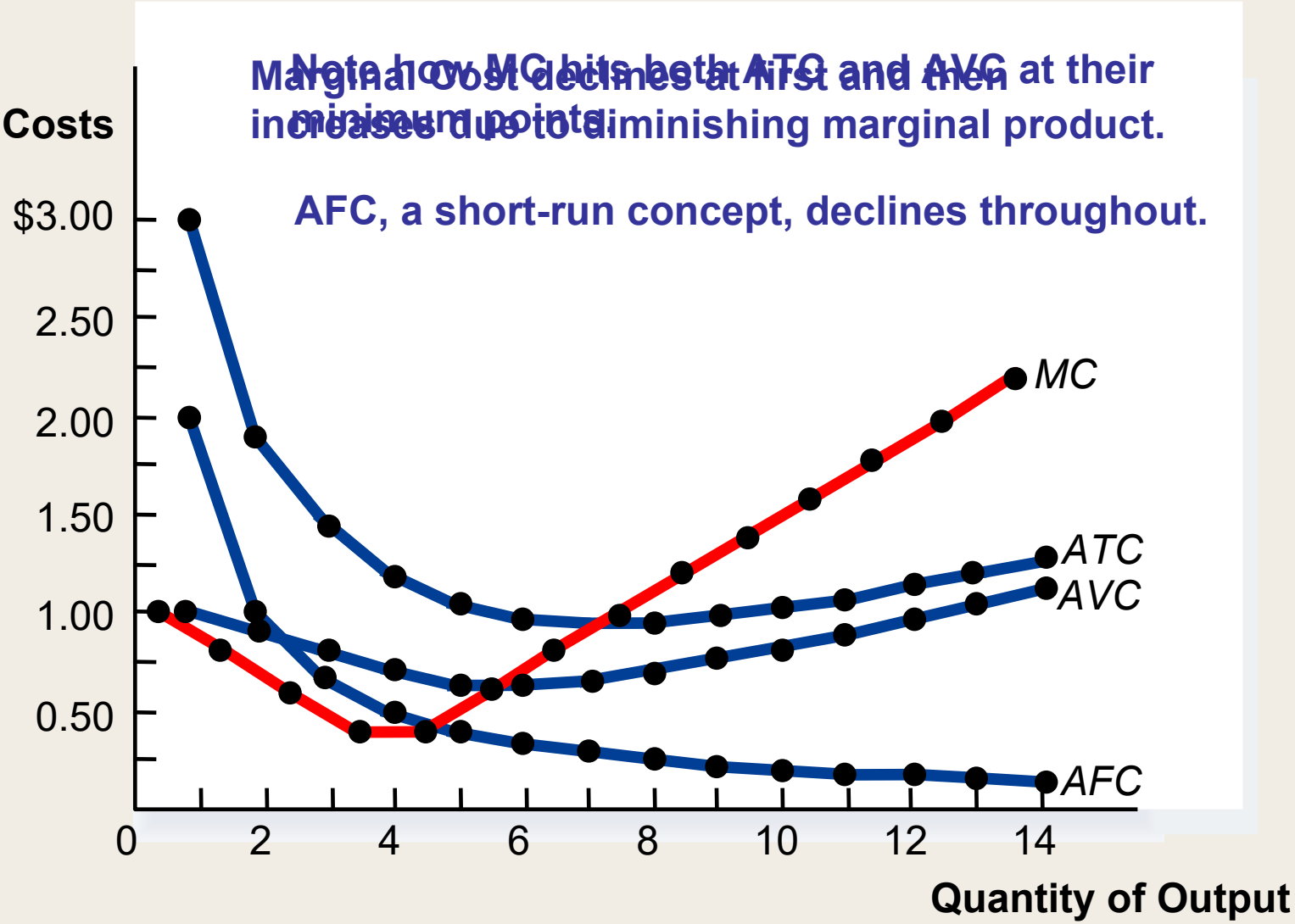
Cost Curves and Their Shapes

- Relationship between Marginal Cost and Average Total Cost
  - The marginal-cost curve crosses the average-total-cost curve at the efficient scale.
    - *Efficient scale* is the quantity that minimizes average total cost.

Typical Cost Curves

- It is now time to examine the relationships that exist between the different measures of cost.

Figure 5 Cost Curves for a Typical Firm



Typical Cost Curves

- Three Important Properties of Cost Curves
  - Marginal cost eventually rises with the quantity of output.
  - The average-total-cost curve is U-shaped.
  - The marginal-cost curve crosses the average-total-cost curve at the minimum of average total cost.

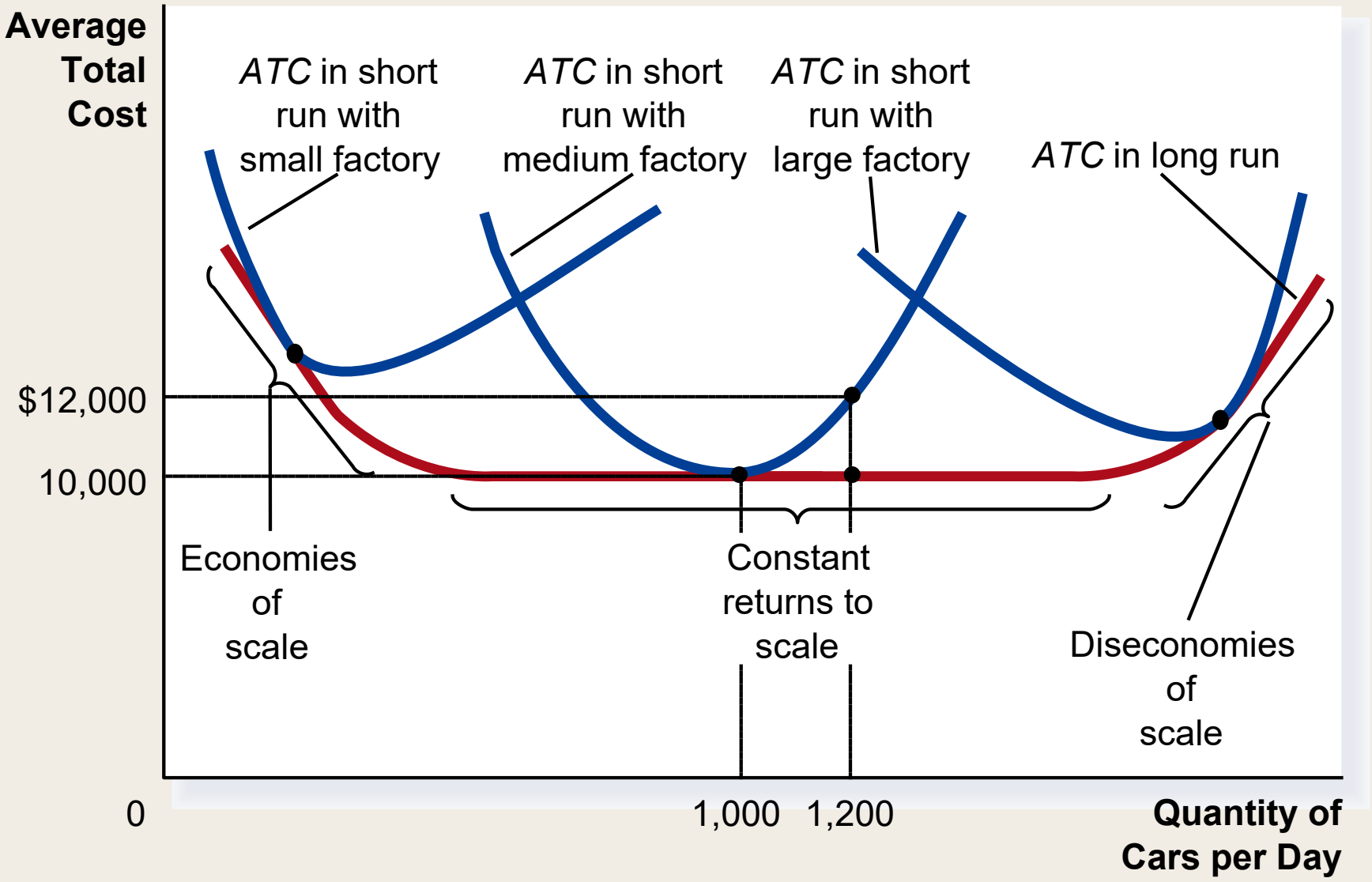
COSTS IN THE SHORT RUN AND IN THE LONG RUN

- For many firms, the division of total costs between fixed and variable costs depends on the time horizon being considered.
  - In the short run, some costs are fixed.
  - In the long run, *all* fixed costs become variable costs.
- Because many costs are fixed in the short run but variable in the long run, a firm's long-run cost curves differ from its short-run cost curves.

Economies and Diseconomies of Scale

- *Economies of scale* refer to the property whereby long-run average total cost falls as the quantity of output increases.
- *Diseconomies of scale* refer to the property whereby long-run average total cost rises as the quantity of output increases.
- *Constant returns to scale* refers to the property whereby long-run average total cost stays the same as the quantity of output increases.

Figure 6 Average Total Cost in the Short and Long Run



Summary

- The goal of firms is to maximize profit, which equals total revenue minus total cost.
- When analyzing a firm's behavior, it is important to include all the opportunity costs of production.
- Some opportunity costs are explicit while other opportunity costs are implicit.

Summary

- A firm's costs reflect its production process.
  - A typical firm's production function gets flatter as the quantity of input increases, displaying the property of diminishing marginal product.
  - A firm's total costs are divided between fixed and variable costs. Fixed costs do not change when the firm alters the quantity of output produced; variable costs do change as the firm alters quantity of output produced.

Summary

- Average total cost is total cost divided by the quantity of output.
- Marginal cost is the amount by which total cost would rise if output were increased by one unit.
- The marginal cost always rises with the quantity of output.
- Average cost first falls as output increases and then rises.

Summary

- The average-total-cost curve is U-shaped.
- The marginal-cost curve always crosses the average-total-cost curve at the minimum of ATC.
- A firm's costs often depend on the time horizon being considered.
- In particular, many costs are fixed in the short run but variable in the long run.