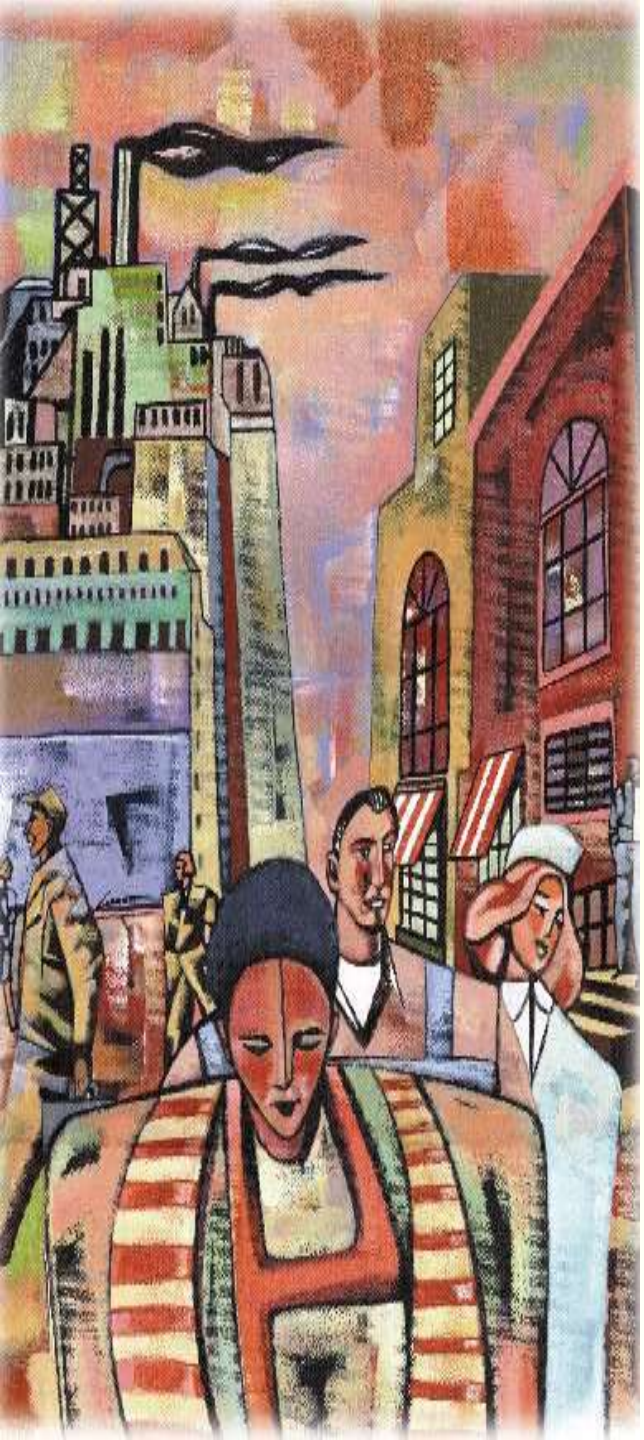


The Costs of Production

The Costs of Production

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.**

The Firm's Objective

The economic goal of the firm is to maximize profits.

A Firm's Total Revenue and Total Cost

- **Total Revenue**
  - **The amount that the firm receives for the sale of its output.**
- **Total Cost**
  - **The amount that the firm pays to buy inputs.**

A Firm's 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** involve a direct money outlay for factors of production.
- **Implicit costs** do not involve a direct money outlay.

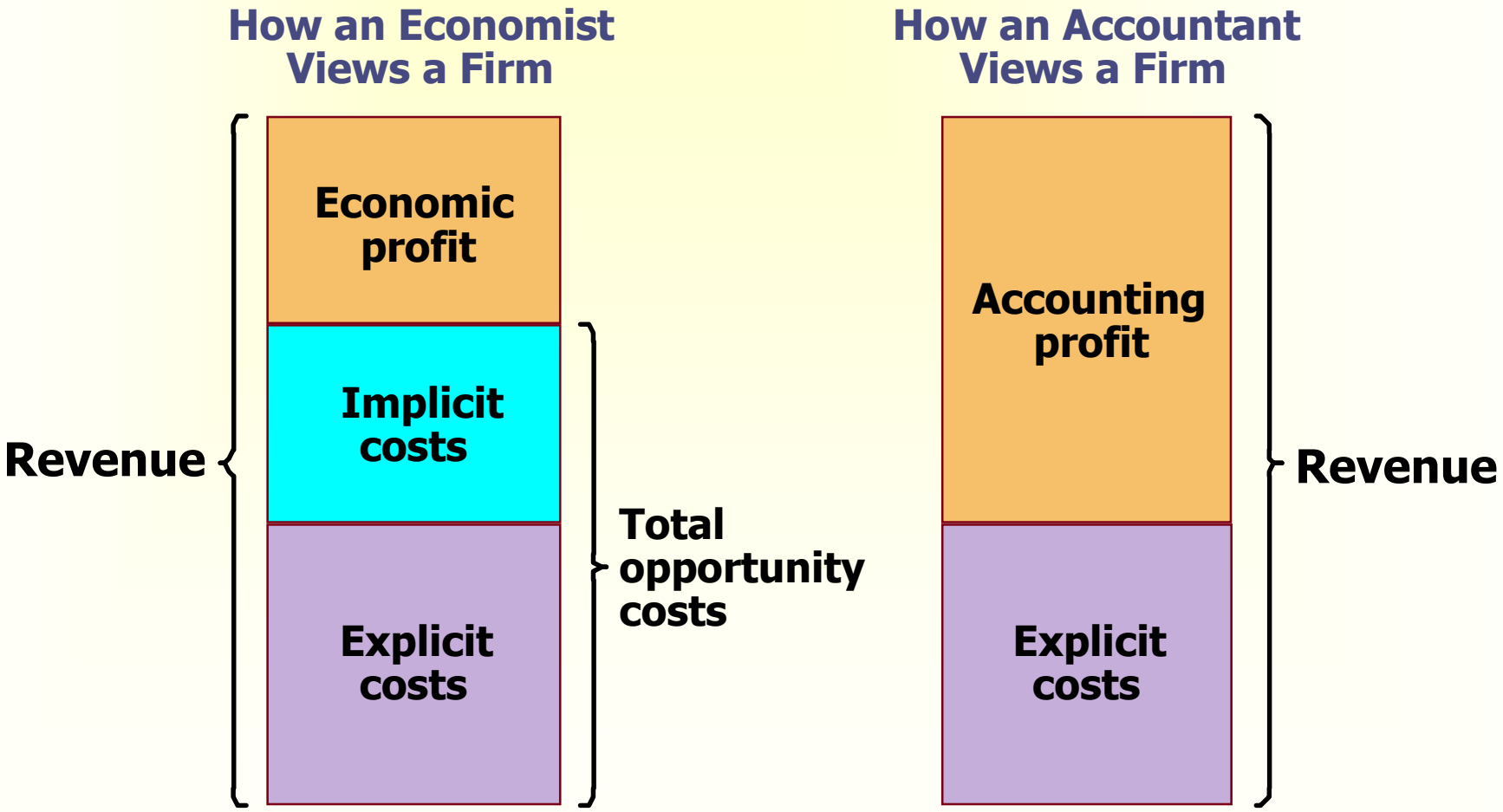
Economic Profit versus Accounting Profit

- Economists measure a firm's **economic profit** as total revenue minus all the opportunity costs (explicit and implicit).
- Accountants measure the **accounting profit** as the firm's total revenue minus only the firm's explicit costs. In other words, they ignore the implicit 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.

Economic Profit versus Accounting Profit



A Production Function and Total Cost

Number of Workers	Output	Marginal Product of Labor	Cost of Factory	Cost of Workers	Total Cost of Inputs
0	0		$30	$0	$30
1	50	50	30	10	40
2	90	40	30	20	50
3	120	30	30	30	60
4	140	20	30	40	70
5	150	10	30	50	80

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.

Marginal Product

The marginal product of any input in the production process is the increase in the quantity of output obtained from an additional unit of that input.

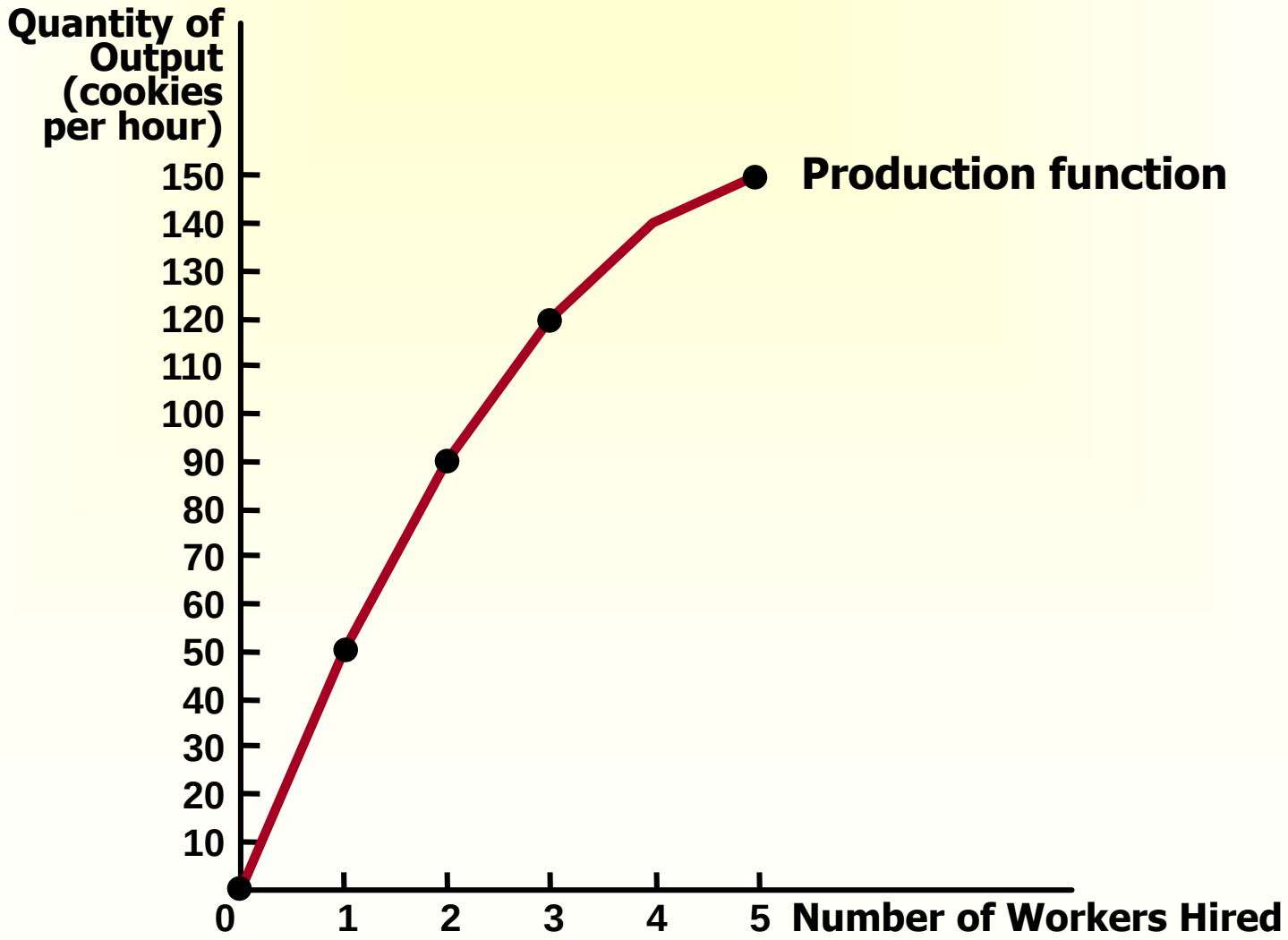
Marginal Product

$$\text{Marginal product} = \frac{\text{Additional output}}{\text{Additional input}}$$

Diminishing Marginal Product

- **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.

A 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

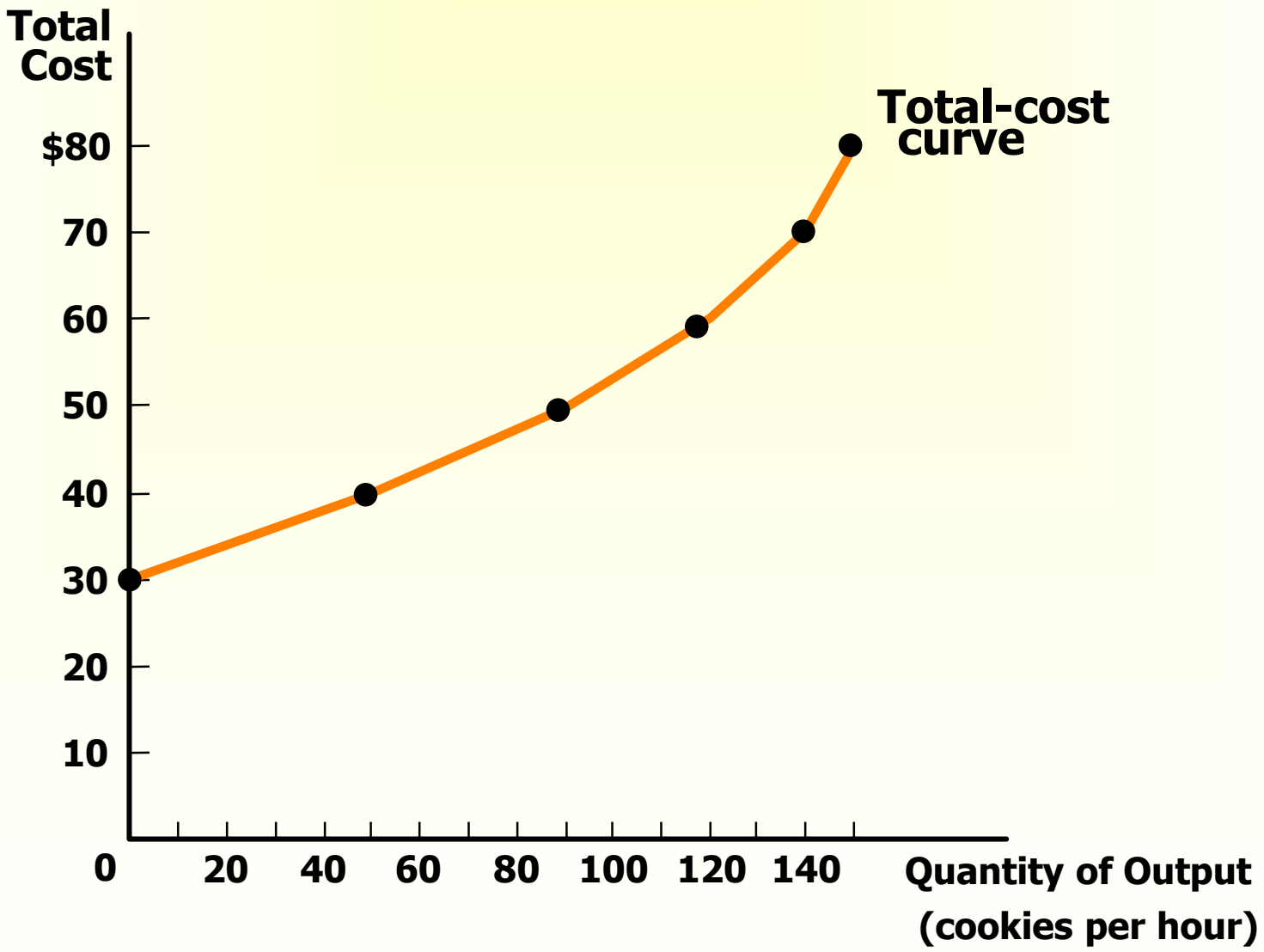
- The relationship between the quantity a firm can produce and its costs determines pricing decisions.
- The *total-cost curve* shows this relationship graphically.

A Production Function and Total Cost

Number of Workers	Output	Marginal Product of Labor	Cost of Factory	Cost of Workers	Total Cost of Inputs
0	0		$30	$0	$30
1	50	50	30	10	40
2	90	40	30	20	50
3	120	30	30	30	60
4	140	20	30	40	70
5	150	10	30	50	80

Hungry Helen's Cookie Factory

Total-Cost Curve...



The Various Measures of Cost

Costs of production may be divided into fixed costs and variable costs.

Fixed 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* change as the firm alters the quantity of output produced.

Family of Total Costs

- Total Fixed Costs (TFC)
- Total Variable Costs (TVC)
- Total Costs (TC)

$$TC = TFC + TVC$$

Family of Total Costs

Quantity	Total Cost	Fixed Cost	Variable Cost
0	$ 3.00	$3.00	$ 0.00
1	3.30	3.00	0.30
2	3.80	3.00	0.80
3	4.50	3.00	1.50
4	5.40	3.00	2.40
5	6.50	3.00	3.50
6	7.80	3.00	4.80
7	9.30	3.00	6.30
8	11.00	3.00	8.00
9	12.90	3.00	9.90
10	15.00	3.00	12.00

Average Costs

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

Family of Average Costs

- Average Fixed Costs (AFC)
- Average Variable Costs (AVC)
- Average Total Costs (ATC)

$$ATC = AFC + AVC$$

Family of Average Costs

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

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

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

Family of Average Costs

Quantity	AFC	AVC	ATC
0	—	—	—
1	$3.00	$0.30	$3.30
2	1.50	0.40	1.90
3	1.00	0.50	1.50
4	0.75	0.60	1.35
5	0.60	0.70	1.30
6	0.50	0.80	1.30
7	0.43	0.90	1.33
8	0.38	1.00	1.38
9	0.33	1.10	1.43
10	0.30	1.20	1.50

Marginal Cost

- **Marginal cost (MC) measures the amount total cost rises when the firm increases production by one unit.**
- **Marginal cost helps answer the following question:**
  - **How much does it cost to produce an additional unit of output?**

Marginal Cost

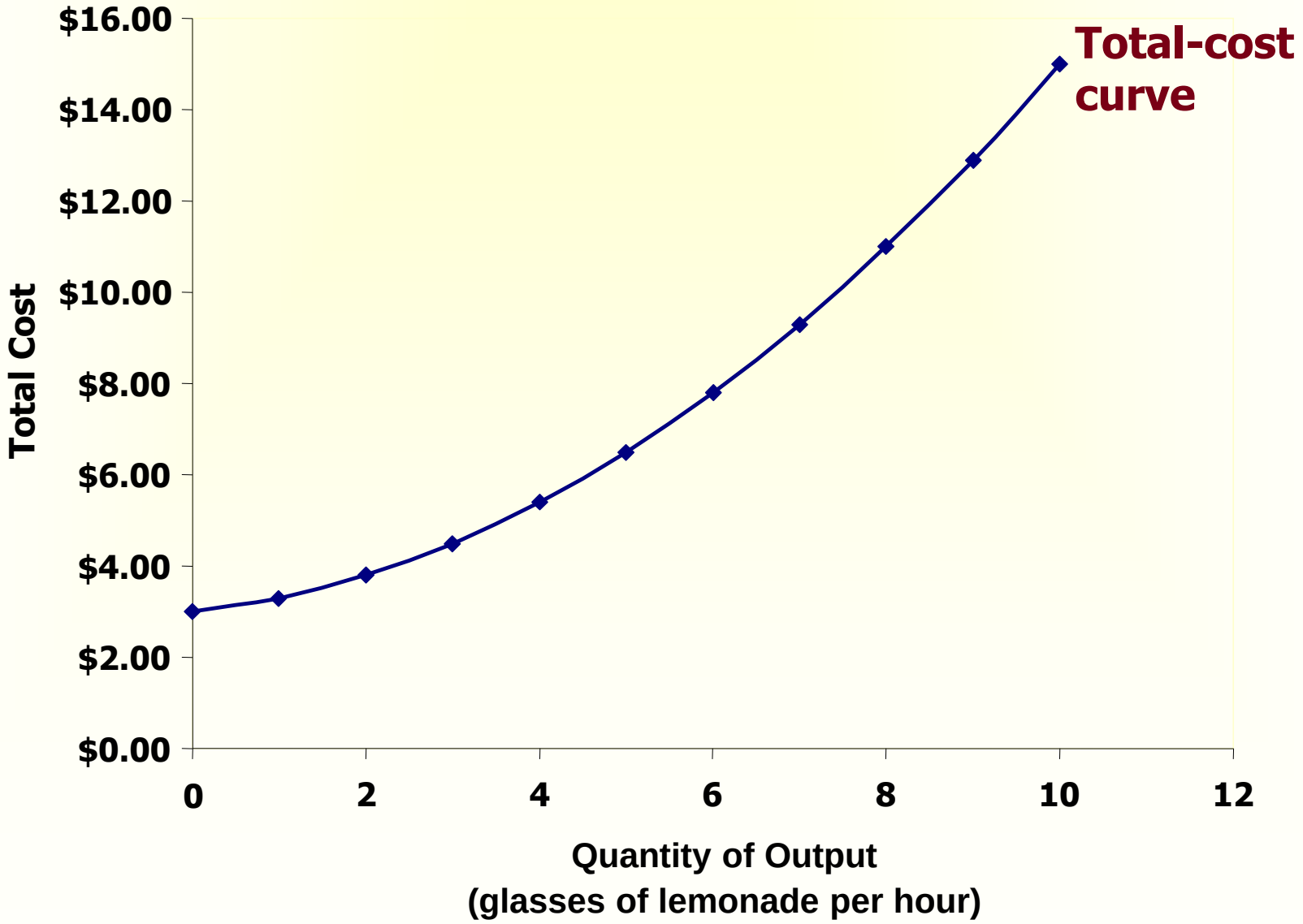
$$MC = \frac{(\text{Change in total cost})}{(\text{Change in quantity})}$$

$$= \Delta TC / \Delta Q$$

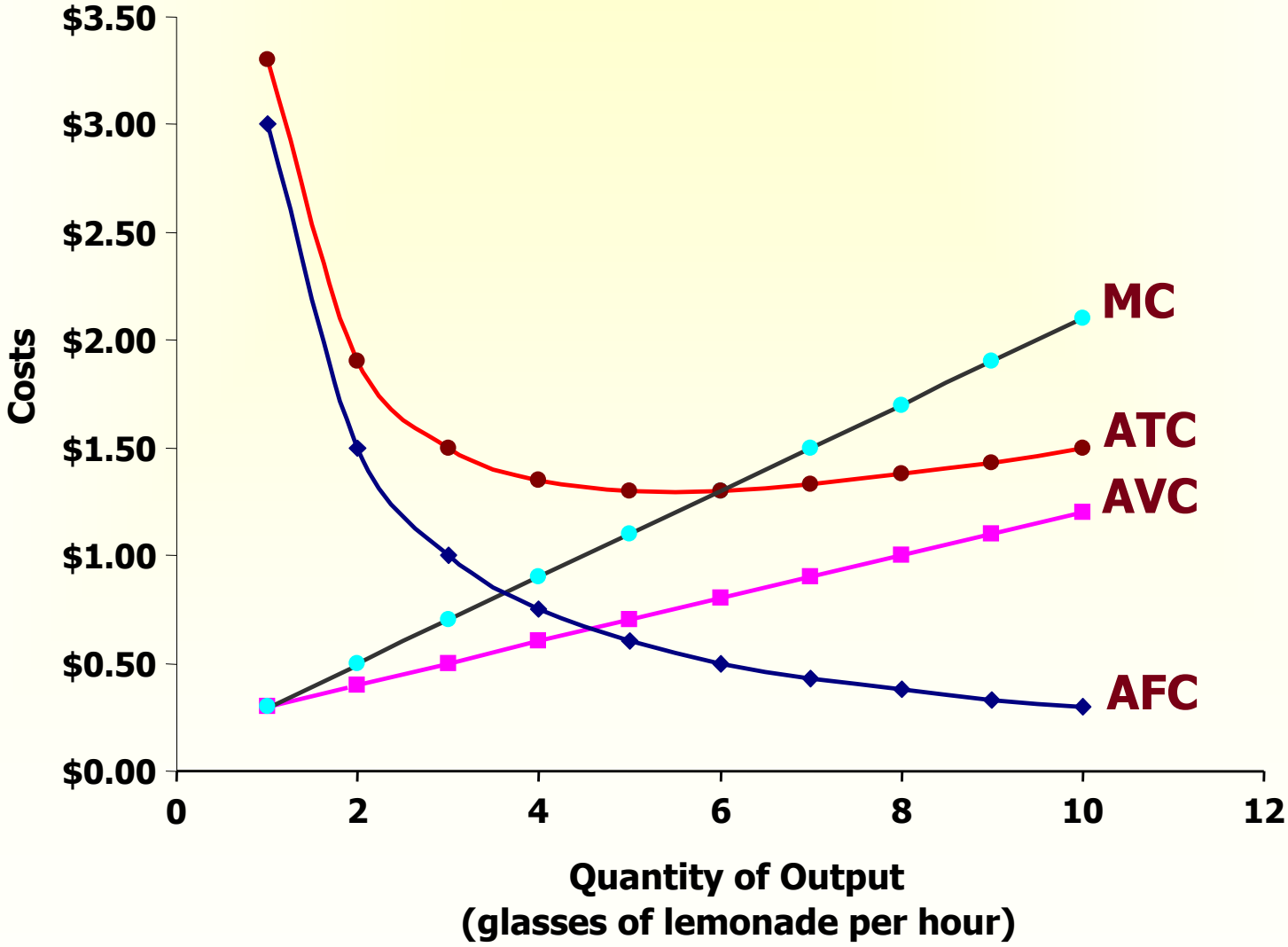
Marginal Cost

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

Total-Cost Curve...



Average-Cost and Marginal-Cost Curves...

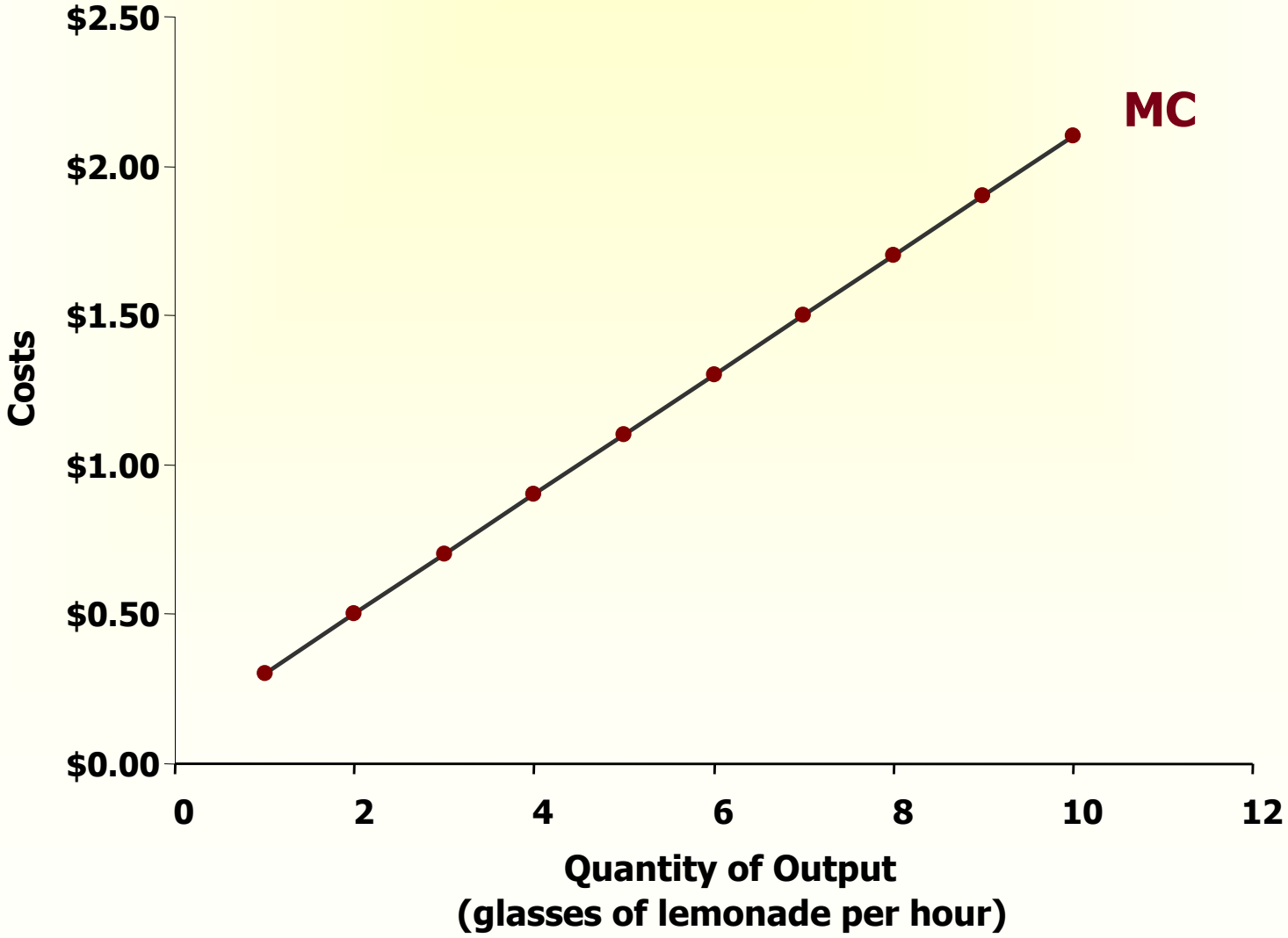


Cost Curves and Their Shapes

Marginal cost rises with the amount of output produced.

- This reflects the property of *diminishing marginal product*.

Cost Curves and Their Shapes



Cost Curves and Their Shapes

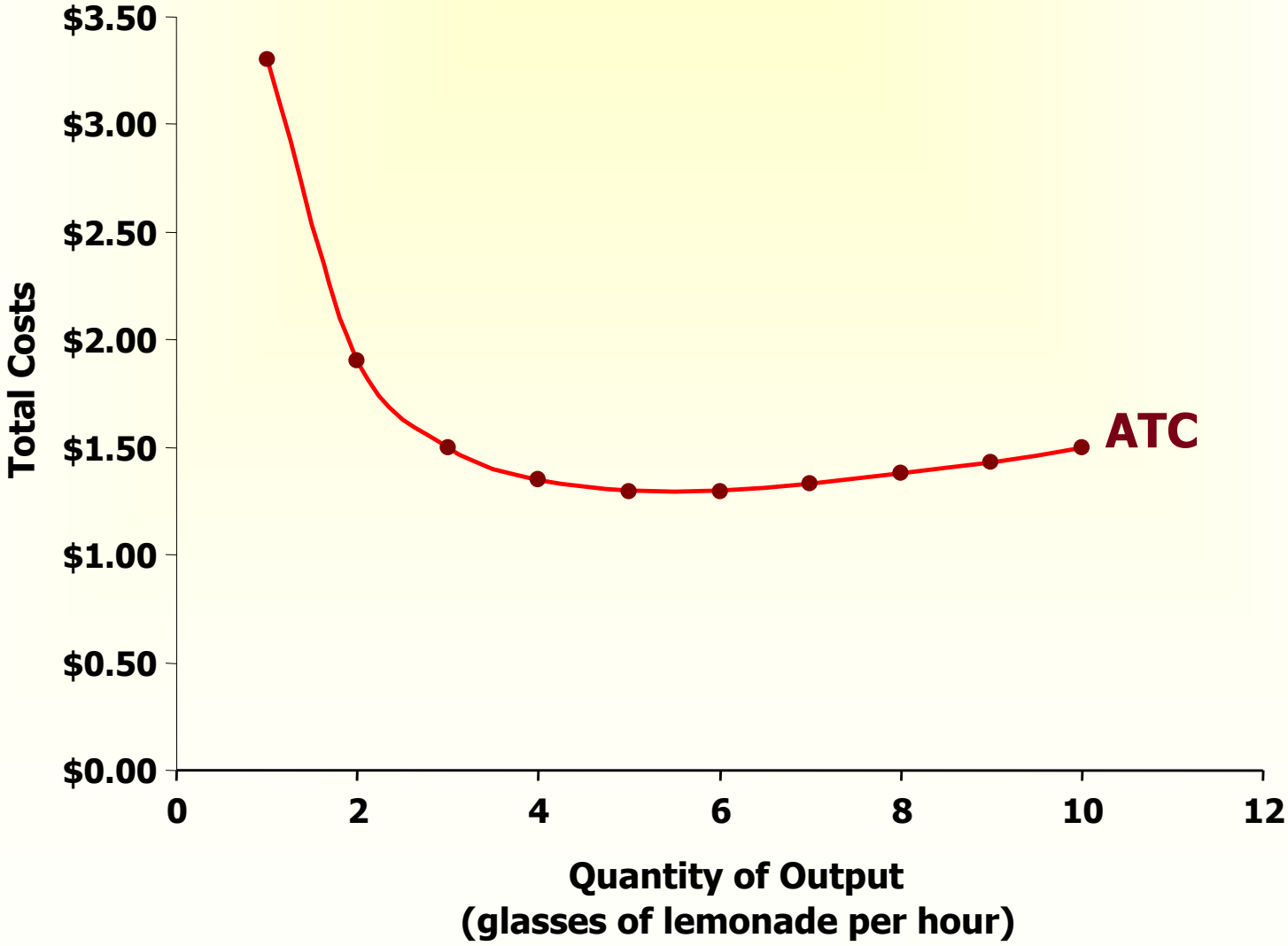
The average total-cost curve is U-shaped.

- **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-shape 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

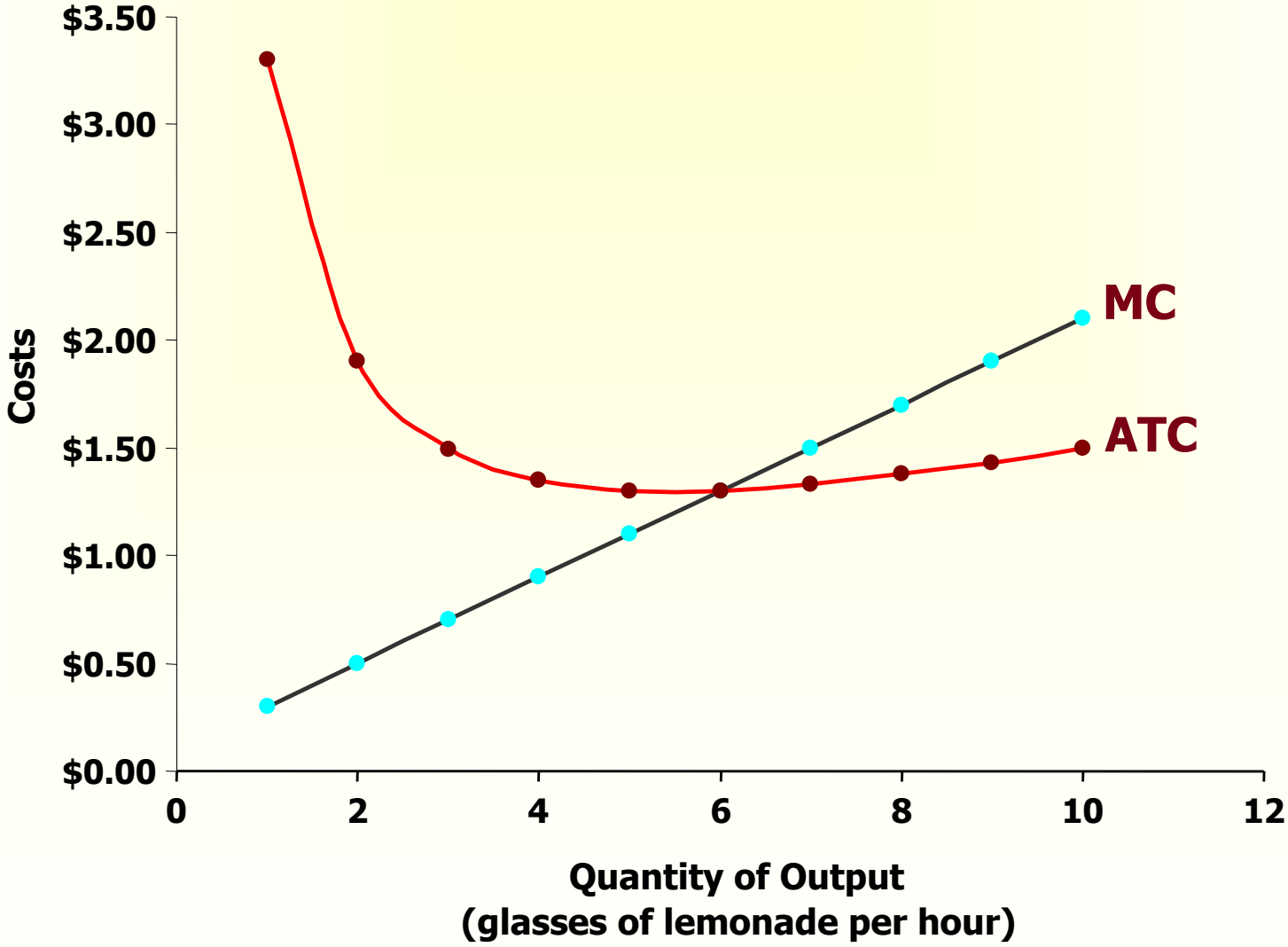
- Whenever marginal cost is less than average total cost, average total cost is falling.
- Whenever marginal cost is greater than average total cost, average total cost is rising.

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.**

Relationship Between Marginal Cost and Average Total Cost



The Various Measures of Cost

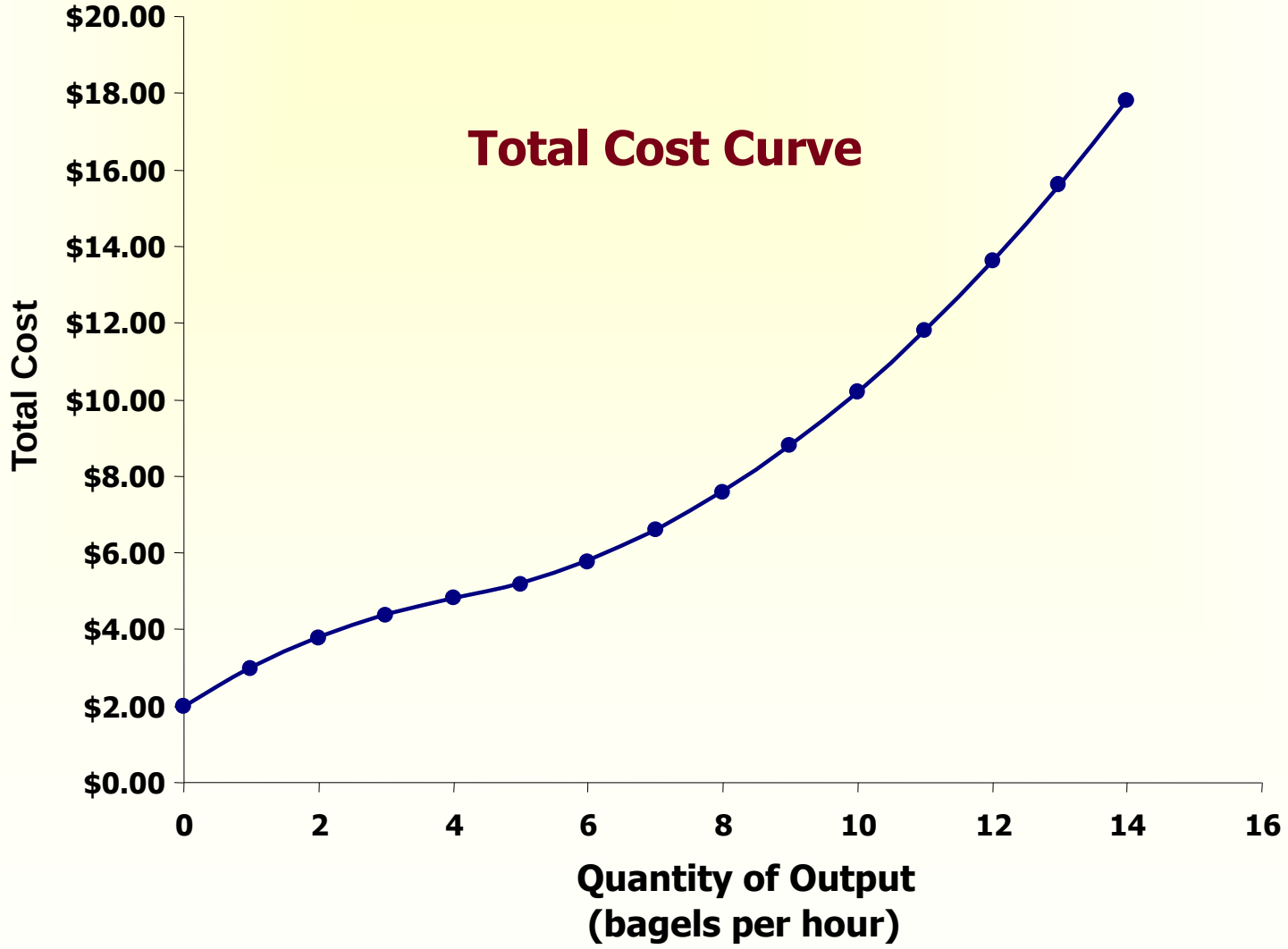
It is now time to examine the relationships that exist between the different measures of cost.

The Various Measures of Cost

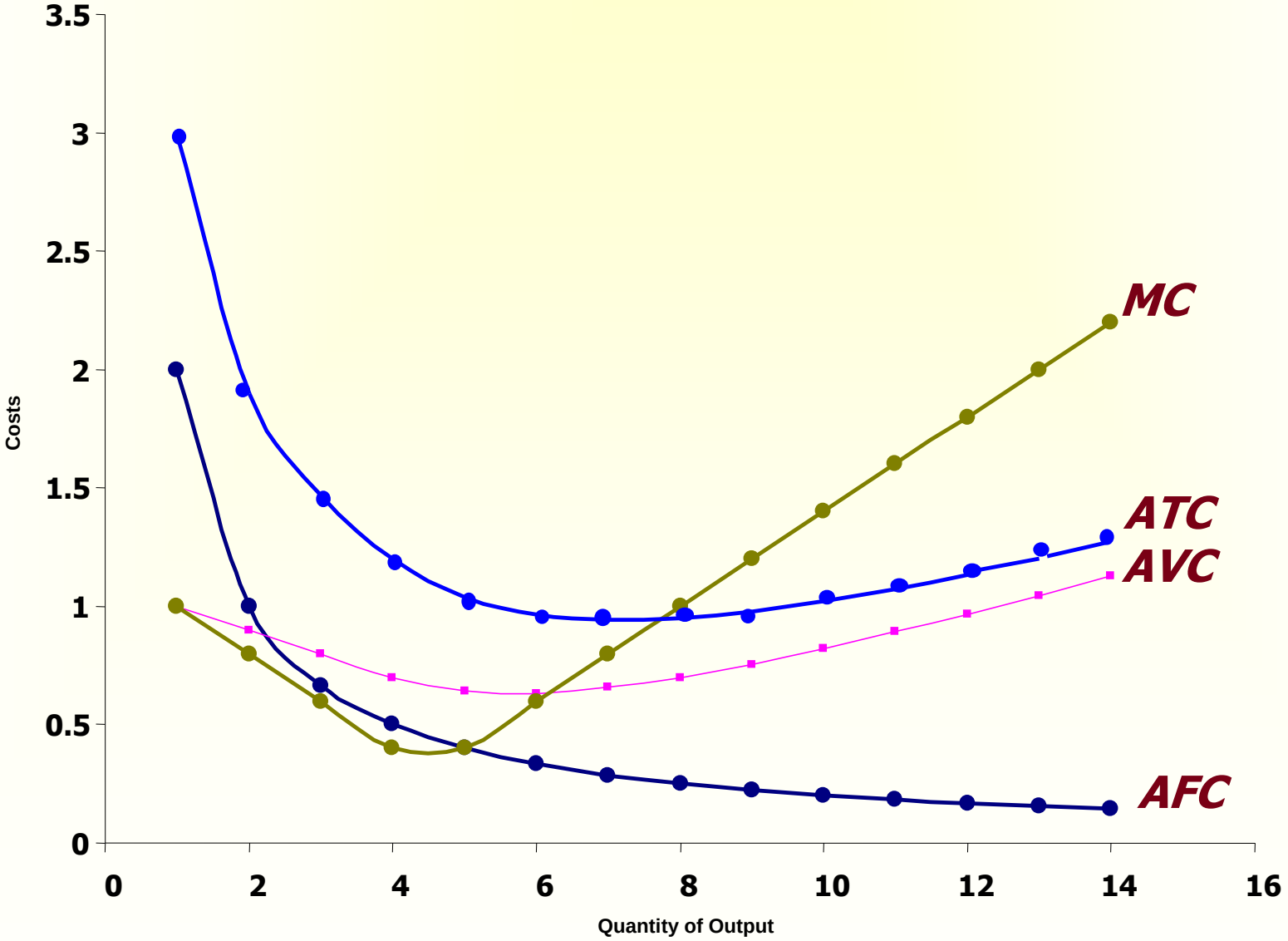
Big Bob's Bagel Bin

Quantity of Bagels	Total Cost	Fixed Cost	Variable Cost	Average Fixed Cost	Average Variable Cost	Average Total Cost	Marginal Cost
0	$2.00	$2.00	$0.00				
1	$3.00	$2.00	$1.00	$2.00	$1.00	$3.00	$1.00
2	$3.80	$2.00	$1.80	$1.00	$0.90	$1.90	$0.80
3	$4.40	$2.00	$2.40	$0.67	$0.80	$1.47	$0.60
4	$4.80	$2.00	$2.80	$0.50	$0.70	$1.20	$0.40
5	$5.20	$2.00	$3.20	$0.40	$0.64	$1.04	$0.40
6	$5.80	$2.00	$3.80	$0.33	$0.63	$0.97	$0.60
7	$6.60	$2.00	$4.60	$0.29	$0.66	$0.94	$0.80
8	$7.60	$2.00	$5.60	$0.25	$0.70	$0.95	$1.00
9	$8.80	$2.00	$6.80	$0.22	$0.76	$0.98	$1.20
10	$10.20	$2.00	$8.20	$0.20	$0.82	$1.02	$1.40
11	$11.80	$2.00	$9.80	$0.18	$0.89	$1.07	$1.60
12	$13.60	$2.00	$11.60	$0.17	$0.97	$1.13	$1.80
13	$15.60	$2.00	$13.60	$0.15	$1.05	$1.20	$2.00
14	$17.80	$2.00	$15.80	$0.14	$1.13	$1.27	$2.20

Big Bob's Cost Curves...



Big Bob's 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.

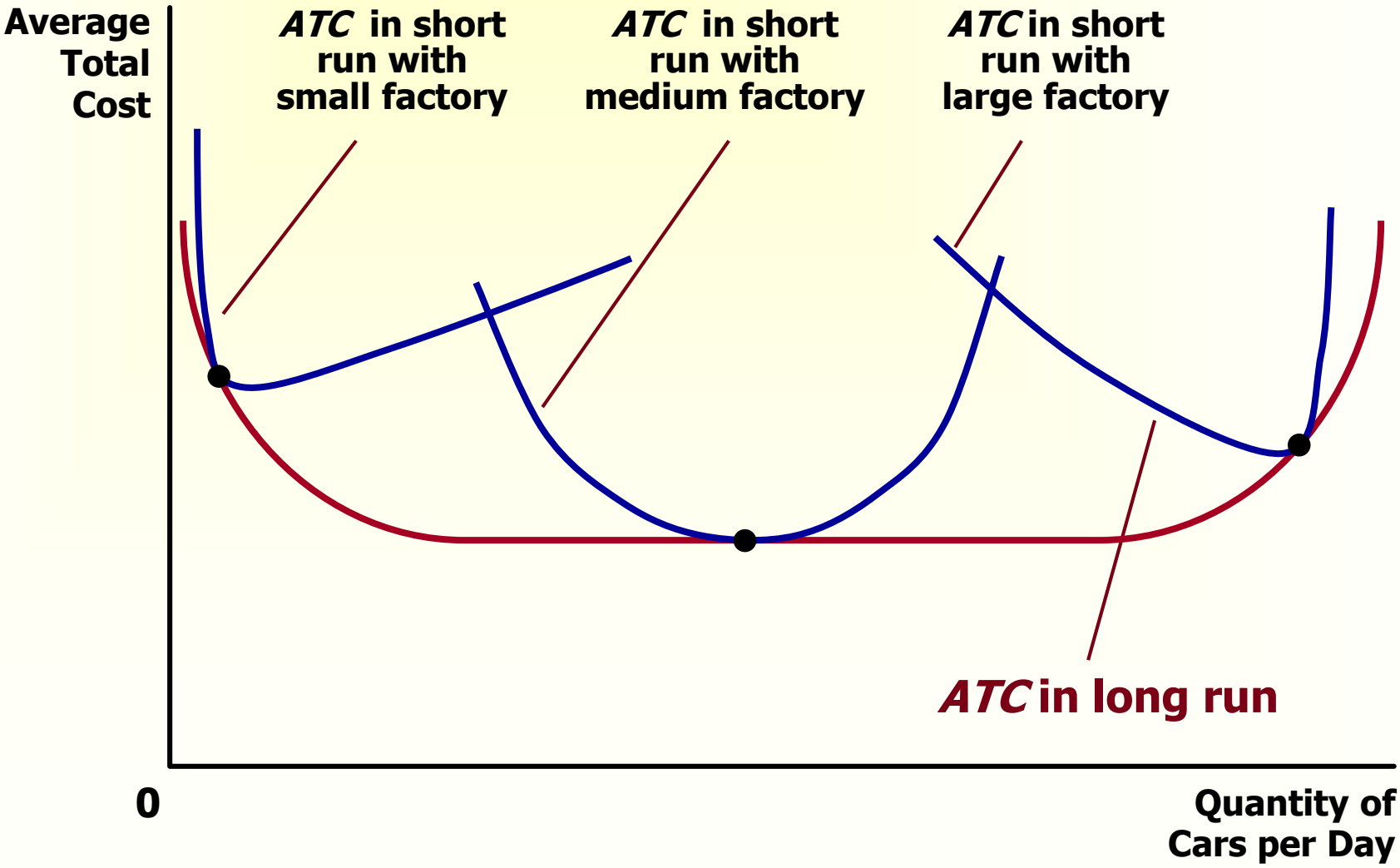
Costs in the Long Run

- 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 fixed costs become variable costs.

Costs in the Long Run

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.

Average Total Cost in the Short and Long Runs...



Economies and Diseconomies of Scale

- **Economies of scale** occur when long-run average total cost declines as output increases.
- **Diseconomies of scale** occur when long-run average total cost rises as output increases.
- **Constant returns to scale** occur when long-run average total cost does not vary as output increases.

Economies and Diseconomies of Scale