Short-Run Costs, Long run Costs and Output Decisions

Costs in the Short Run

- **Fixed cost**   Any cost that does not depend on the firm's level of output. These costs are incurred even if the firm is producing nothing. There are no fixed costs in the long run.

- **Variable cost** A cost that depends on the level of production chosen.

- **Total cost (*TC*)** Total fixed costs plus total variable costs.

$$TC = TFC + TVC$$

Fixed Costs

Total Fixed Cost (*TFC*)

• **Total fixed costs (*TFC*) or overhead** The total of all costs that do not change with output even if output is zero.

**Short-Run Fixed Cost (Total and Average) of a Hypothetical Firm**

(1)	(2)	(3)
q	*TFC*	*AFC (TFC/q)*
0	$100	$—
1	100	100
2	100	50
3	100	33
4	100	25
5	100	20

Fixed Costs

Average Fixed Cost (*AFC*)

- **average fixed cost (*AFC*)** Total fixed cost divided by the number of units of output; a per-unit measure of fixed costs.

- As output increases, average fixed cost declines because we are dividing a fixed number ($1,000) by a larger and larger quantity.

- **spreading overhead** The process of dividing total fixed costs by more units of output. Average fixed cost declines as quantity rises.

Short-Run Fixed Cost (Total and Average) of a Hypothetical Firm

a. Total fixed cost

b. Average fixed cost
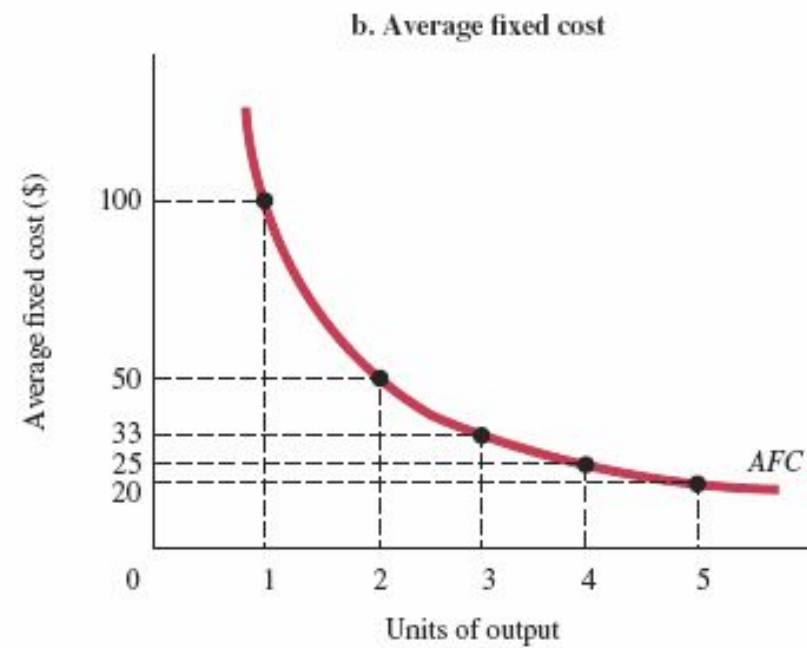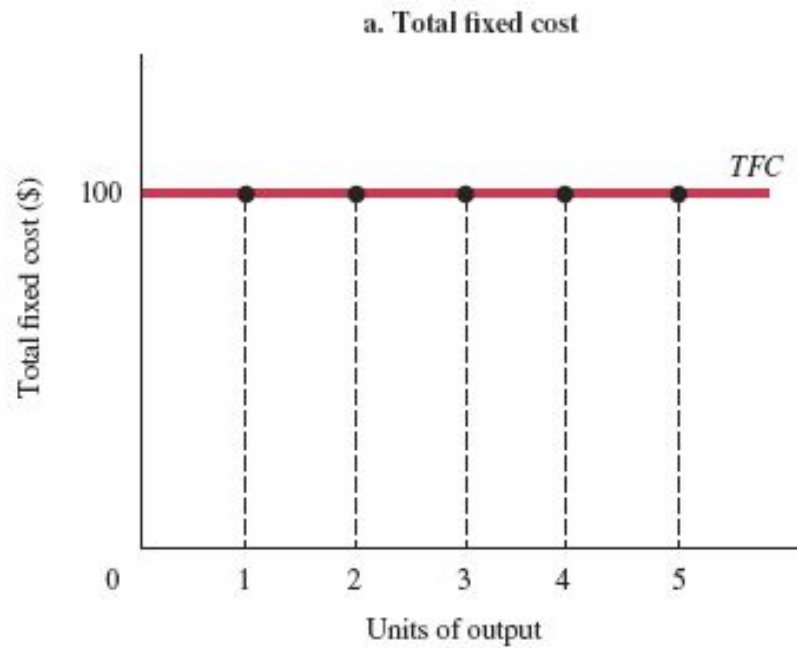
$$AFC = \frac{TFC}{q}$$

Variable Costs

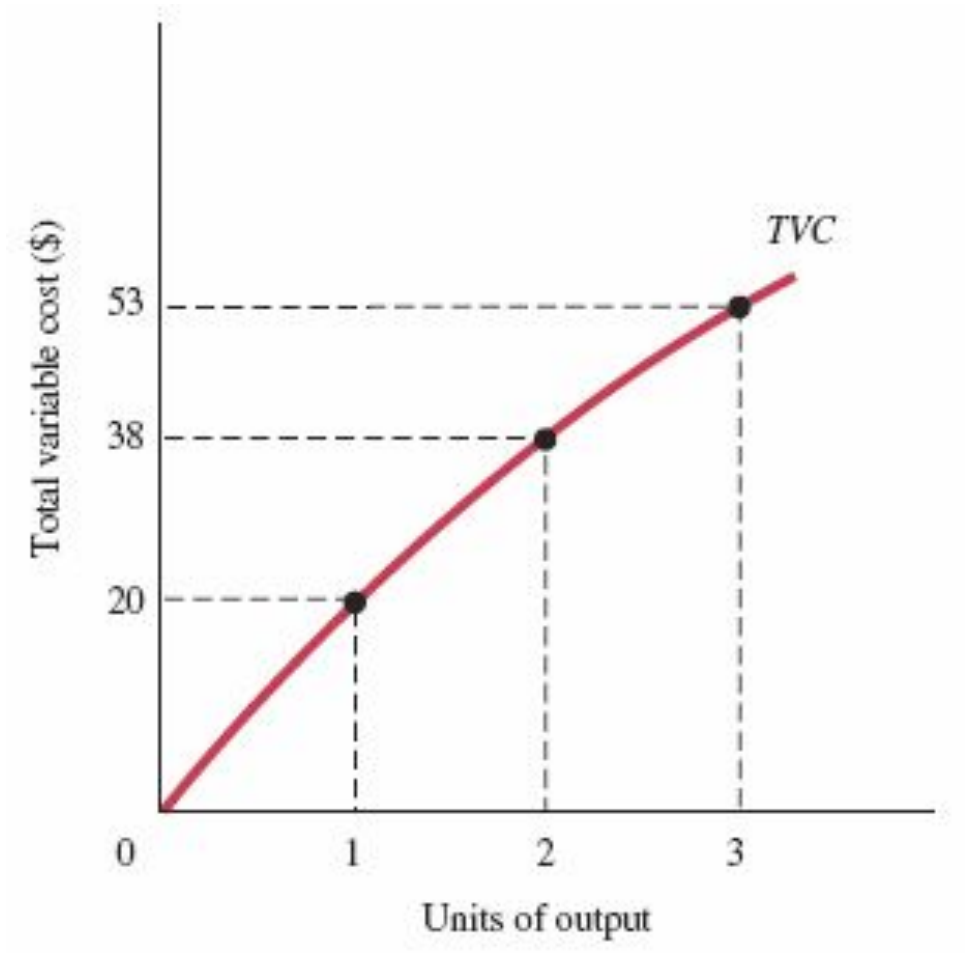**Total Variable Cost (*TVC*)**

- **total variable cost (*TVC*)** The total of all costs that vary with output in the short run.

- **total variable cost curve** A graph that shows the relationship between total variable cost and the level of a firm's output.

- A total variable cost curve expresses the relationship between *TVC* and total output.

Derivation of Total Variable Cost Schedule from Technology and Factor Prices

Produce	Using Technique	Units of Input Required (Production Function		Total Variable Cost Assuming PK = $2, PL = $1 TVC = (K × PK) + (L × PL)
		K	L	
1 unit of output	A	10	7	
	B	6	8	(6 × $2) + (8 × $1) = $20
2 units of output	A	16	8	(16 × $2) + (8 × $1) = $40
	B	11	16	(11 × $2) + (16 × $1) = $38
3 units of output	A	19	15	(19 × $2) + (15 × $1) = $38
	B	18	22	(18 × $2) + (22 × $1) = $58

In this table, total variable cost is derived from production requirements and input prices.

Total Variable Cost Curve

Variable Costs

Marginal Cost (*MC*)

- **marginal cost (*MC*)** The increase in total cost that results from producing 1 more unit of output. Marginal costs reflect changes in variable costs.

Derivation of Marginal Cost from Total Variable Cost

Units of Output	Total Variable Costs ($)	Marginal Costs ($)
0	0	
1	20	20
2	38	18
3	53	15

Variable Costs

The Shape of the Marginal Cost Curve in the Short Run

- In the short run, every firm is constrained by some fixed input that (1) leads to diminishing returns to variable inputs and (2) limits its capacity to produce.

- As a firm approaches that capacity, it becomes increasingly costly to produce successively higher levels of output.

- Marginal costs ultimately increase with output in the short run.

Example

1. Given the following cost function is TC = 10 + 2Q

a) Fixed cost

b) Average fixed cost

c) Variable cost

d) Average variable cost

e) Average total cost

f) Marginal cost

Example

2. The short-run cost function of a firm is given by $C = 190 + 53Q$

a) What is fixed cost?

b) If the firm produces 100 units of output, what is the average variable cost?

c) What is its marginal cost?

d) What is its average fixed cost function?

Declining Marginal Product Implies That Marginal Cost Will Eventually Rise with Output
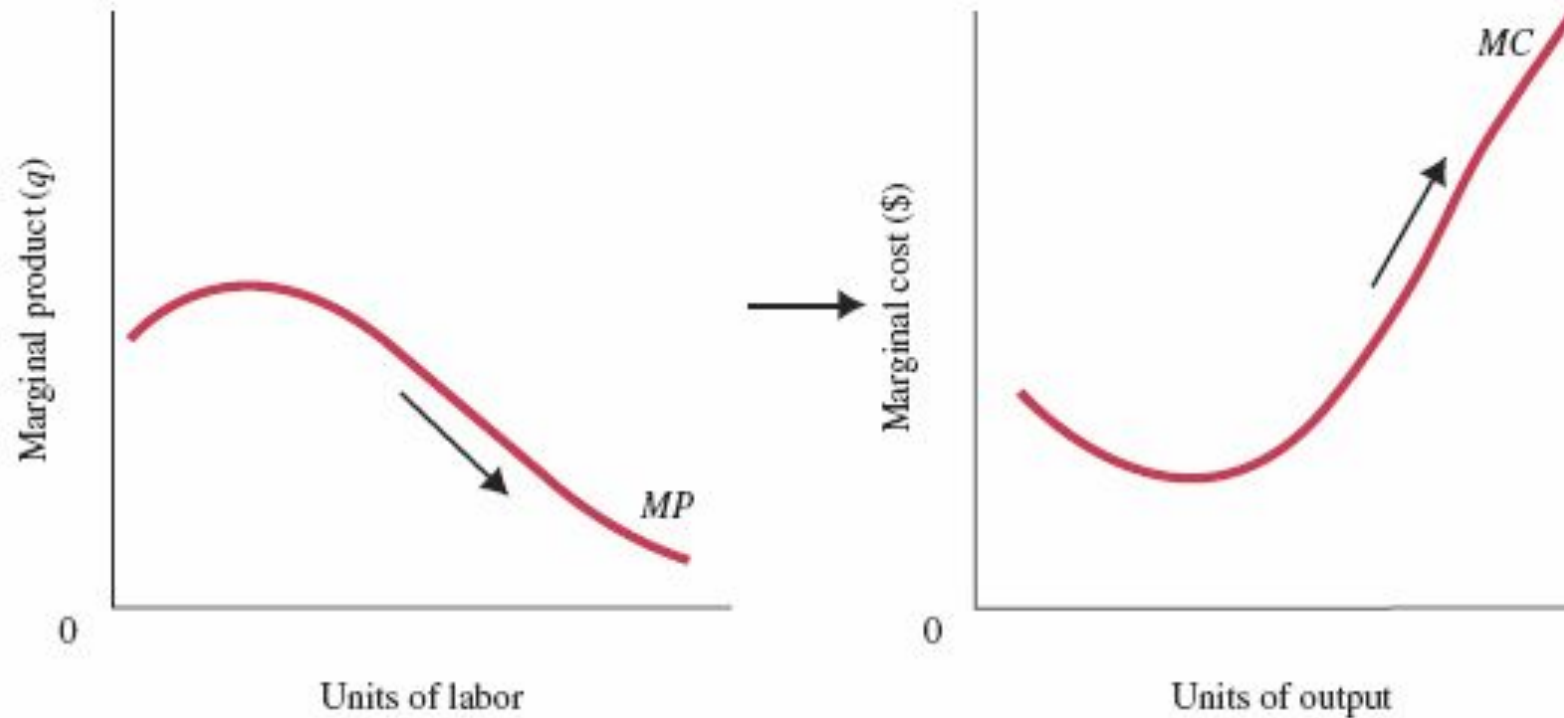

In the short run, every firm is constrained by some fixed factor of production.
A fixed factor implies diminishing returns (declining marginal product) and a limited capacity to produce. As that limit is approached, marginal costs rise.

Variable Costs

Graphing Total Variable Costs and Marginal Costs

- Total variable costs always increase with output.

- Marginal cost is the cost of producing each additional unit.

Total Variable Cost and Marginal Cost for a Typical Firm
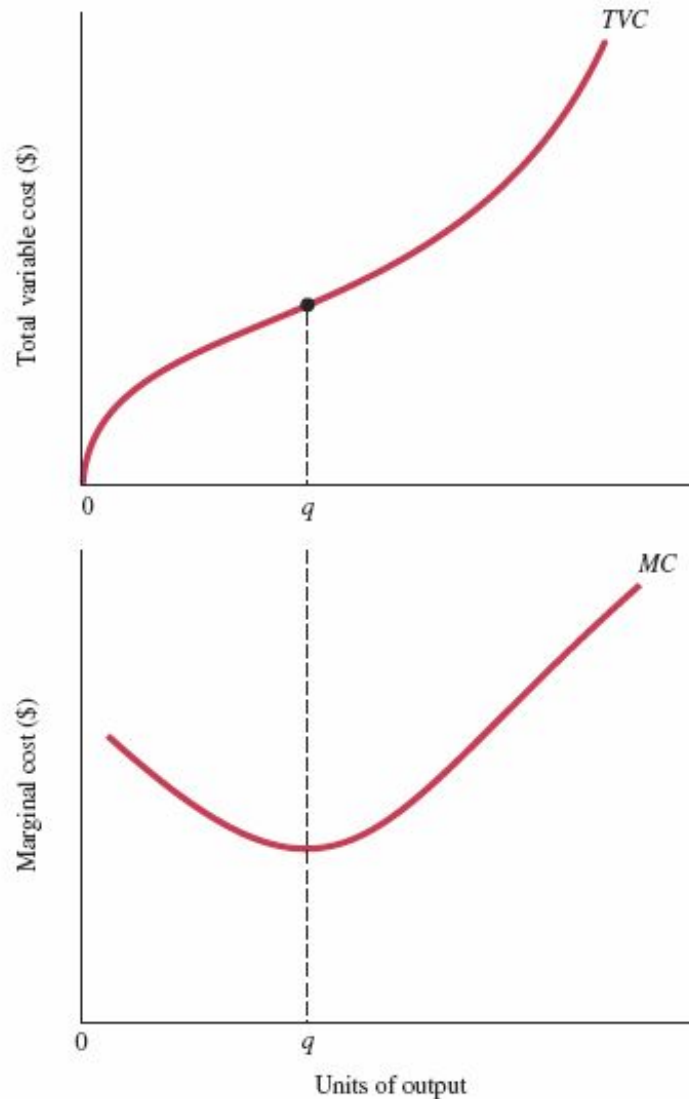
Total variable costs always increase with output.

Marginal cost is the cost of producing each additional unit.

Thus, the marginal cost curve shows how total variable cost changes with single-unit increases in total output.

Variable Costs

Average Variable Cost (AVC)

- **average variable cost (*AVC*)** Total variable cost divided by the number of units of output; a per-unit measure of variable costs.

$$AVC = \frac{TVC}{q}$$

Short-Run Costs of a Hypothetical Firm

(1) q	(2) TVC	(3) MC (Δ TVC)	(4) AVC (TVC/q)	(5) TFC	(6) TC (TVC + TFC)	(7) AFC (TFC/q)	(8) ATC (TC/q or AFC + AVC)
0	$ 0.00	$ —	$ —	$ 100.00	$ 100.00	$ —	$ —
1	20.00	20.00	20.00	100.00	120.00	100.00	120.00
2	38.00	18.00	19.00	100.00	138.00	50.00	69.00
3	53.00	15.00	17.66	100.00	153.00	33.33	51.00
4	65.00	12.00	16.25	100.00	165.00	25.00	41.25
5	75.00	10.00	15.00	100.00	175.00	20.00	35.00
6	83.00	8.00	13.83	100.00	183.50	16.67	30.50
7	94.50	11.50	13.50	100.00	194.50	14.28	27.78
8	108.00	13.50	13.50	100.00	208.00	12.50	26.00
9	128.50	20.50	14.28	100.00	228.50	11.11	25.39
10	168.50	40.00	16.85	100.00	268.50	10.00	26.85

Variable Costs

**Graphing Average Variable Costs and Marginal Costs**

- When marginal cost is *below* average cost, average cost is declining.

- When marginal cost is *above* average cost, average cost is increasing.

- Rising marginal cost intersects average variable cost at the minimum point of *AVC*.

FIGURE 8.6 More Short-Run Costs
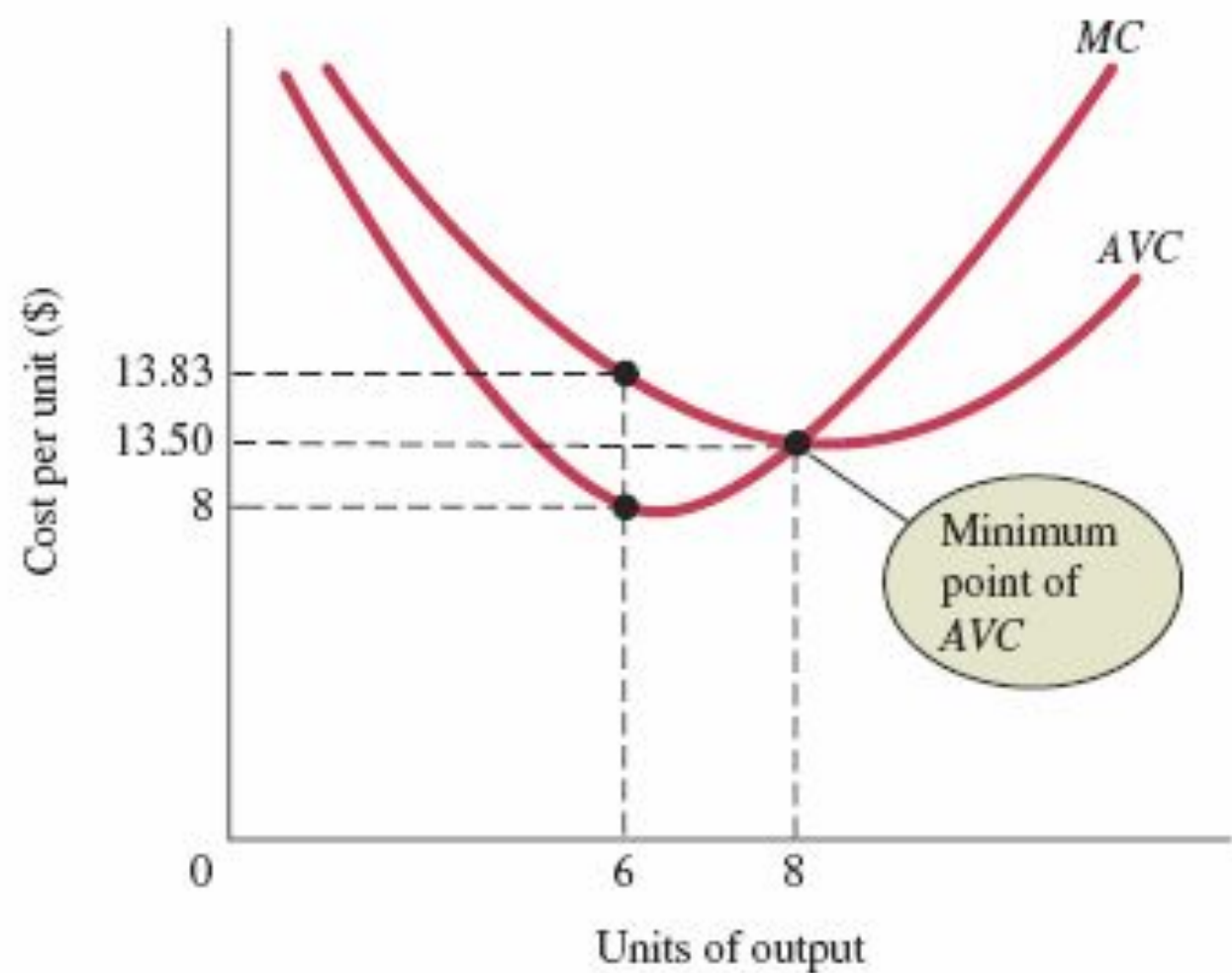
Total Costs

FIGURE 8.7 Total Cost = Total Fixed Cost + Total Variable Cost
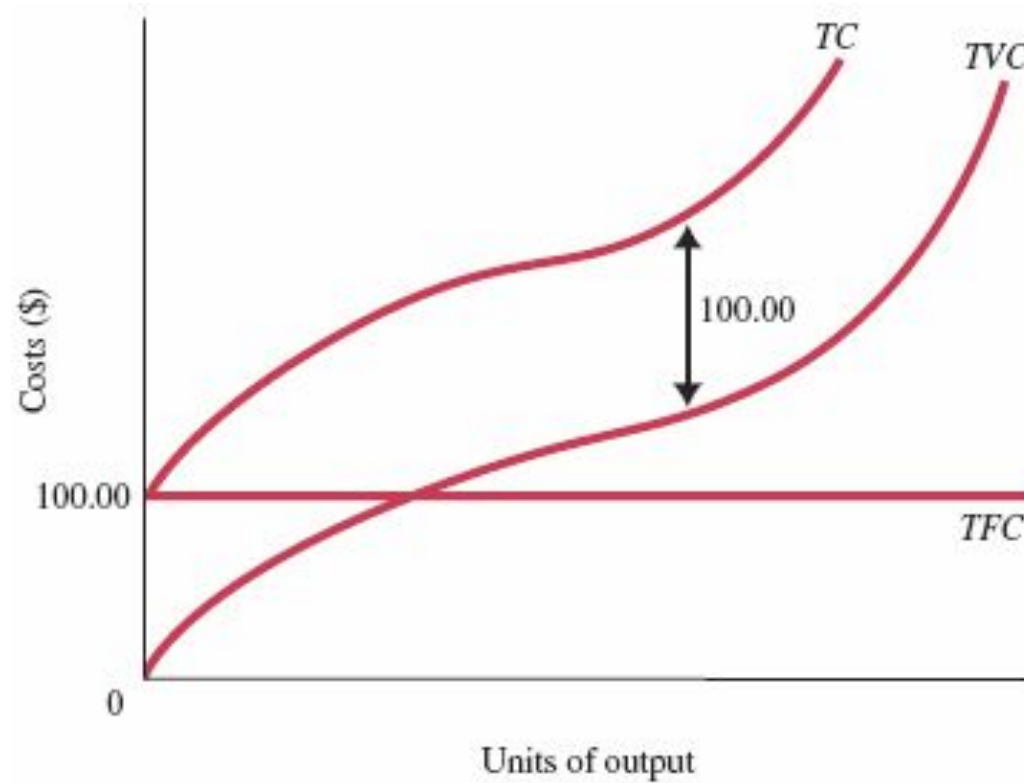
Total Costs

- Adding *TFC* to *TVC* means adding the same amount of total fixed cost to every level of total variable cost.

- Thus, the total cost curve has the same shape as the total variable cost curve; it is simply higher by an amount equal to *TFC*.
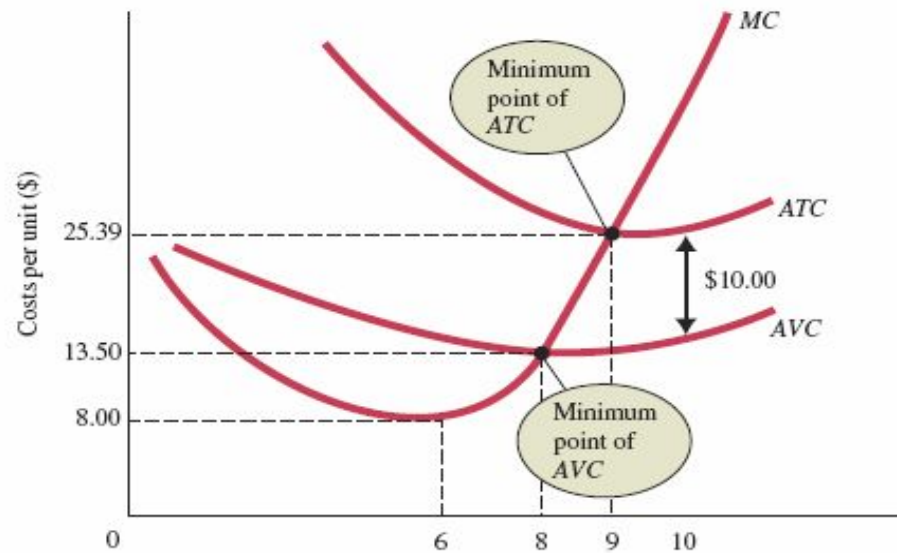
Total Costs

Average Total Cost (*ATC*)

- **average total cost (*ATC*)** Total cost divided by the number of units of output; a per-unit measure of total costs.
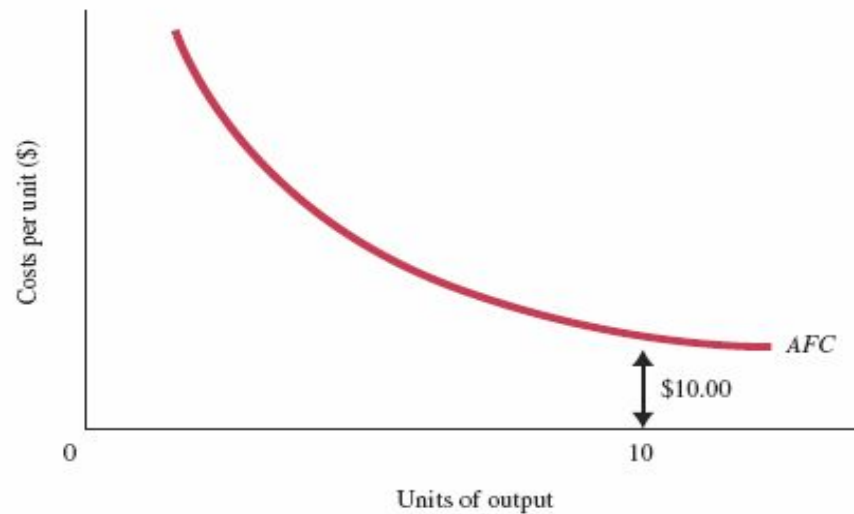
$$ATC = \frac{TC}{q}$$

Average Total Cost = Average Variable Cost + Average Fixed Cost

To get *ATC*, we add average fixed and average variable costs at all levels of output.

Because average fixed cost falls with output, an ever-declining amount is added to *AVC*.

Thus, *AVC* and *ATC* get closer together as output increases, but the two lines never meet.

Total Costs

The Relationship between Average Total Cost and Marginal Cost

- This relationship is the same as the relationship between *AVC* and *MC*.

- If *MC* is *below ATC*, *ATC* will *decline* toward *MC*.

- If *MC* is *above ATC*, *ATC* will *increase*.

- As a result, *MC* intersects *ATC* at *ATC*'s minimum point for the same

  reason that it intersects the *AVC* curve at its minimum point.

Short-Run Costs: A Review

A Summary of Cost Concepts

Term	Definition	Equation
Accounting costs	Out-of-pocket costs, or costs as an accountant would define them. Sometimes referred to as *explicit costs*.	—
Economic costs	Costs that include the full opportunity costs of all inputs. These include what are often called *implicit costs*.	—
Total fixed costs (*TFC*)	Costs that do not depend on the quantity of output produced. These must be paid even if output is zero.	—
Total variable costs (*TVC*)	Costs that vary with the level of output.	—
Total cost (*TC*)	The total economic cost of all the inputs used by a firm in production.	$TC = TFC + TVC$
Average fixed costs (*AFC*)	Fixed costs per unit of output.	$AFC = TFC/q$
Average variable costs (*AVC*)	Variable costs per unit of output.	$AVC = TVC/q$
Average total costs (*ATC*)	Total costs per unit of output.	$ATC = TC/q$ $ATC = AFC + AVC$
Marginal costs (*MC*)	The increase in total cost that results from producing 1 additional unit of output.	$MC = \Delta TC/\Delta q$

LONG-RUN COSTS

- In the long-run there are no fixed inputs, and therefore no fixed costs. All costs are variable.

- Another way to look at the long-run is that in the long-run a firm can choose any amount of fixed costs it wants for making short-run decisions.

The Long-run Average Cost Curve

The <u>long-run average cost curve</u> shows the minimum average cost at each output level when all inputs are variable, that is, when the firm can have any plant size it wants.
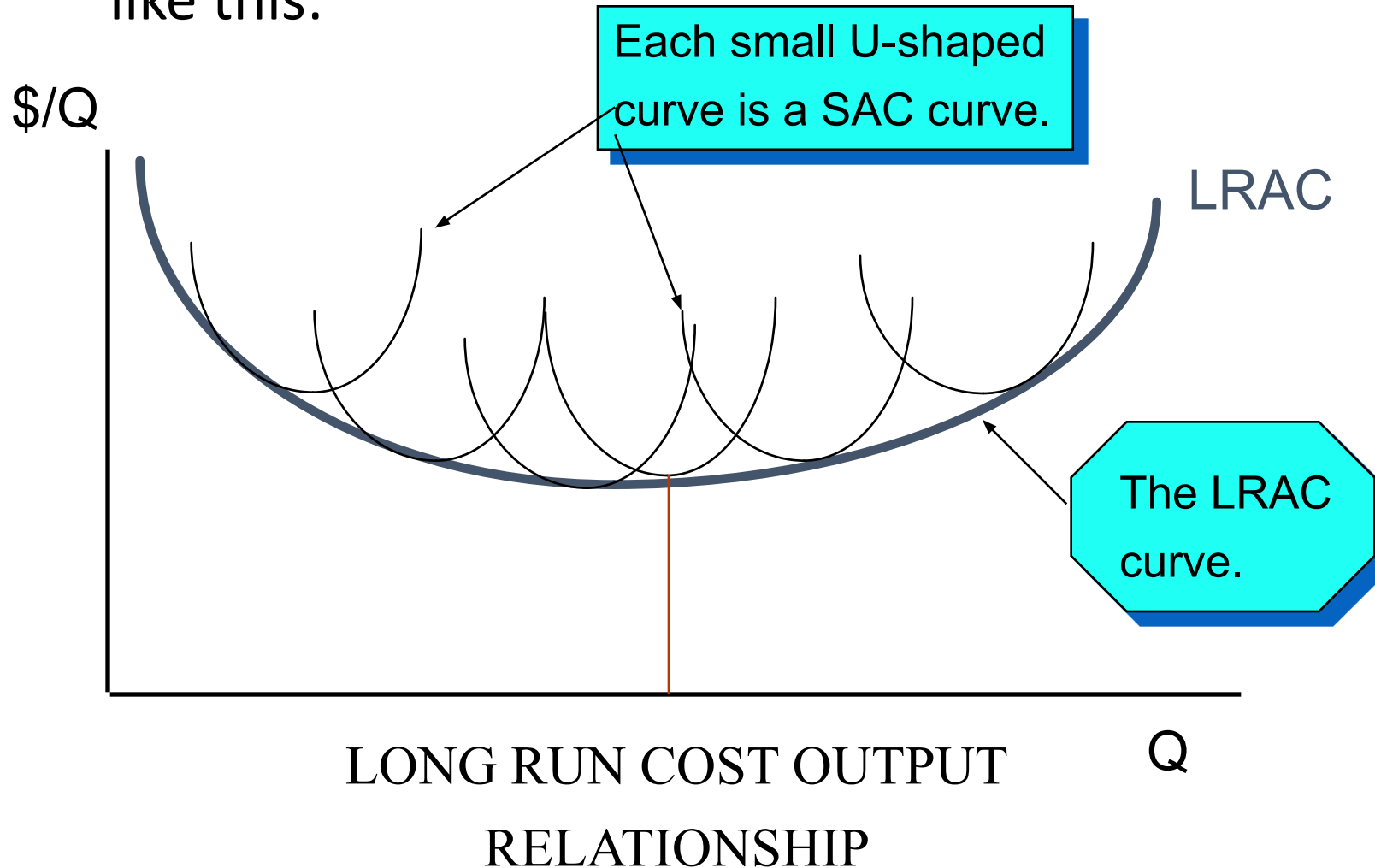
There is a relationship between the LRAC curve and the firm's set of short-run average cost curves.

SR and LR Average Costs

- Economists use the term "plant size" to talk about having a particular amount of fixed inputs. Choosing a different amount of plant and equipment (plant size) amounts to choosing an amount of fixed costs.

- Economists want you to think of fixed costs as being associated with plant and equipment. Bigger plants have larger fixed costs.

- If each plant size is associated with a different amount of fixed costs, then each plant size for a firm will give us a different set of short-run cost curves.

- Choosing a different plant size (a long-run decision) then means moving from one short-run cost curve to another.

- Economists usually assume that plant size is infinitely divisible (variable). In the case of finely divisible plant size, the LRAC curve might look like this:

$/Q

Each small U-shaped curve is a SAC curve.

LRAC

The LRAC curve.

LONG RUN COST OUTPUT

RELATIONSHIP

Q

- In the preceding graph, each short-run cost curve corresponds to a particular amount of fixed inputs.

- As the fixed input amount increases in the long run, you move to different SR cost curves, each one corresponding to a particular plant size.

- Notice in the graphs of LRAC curves presented so far that the curves have been drawn to be U-shaped. That is, when output is increasing LRAC at first falls, and then eventually rises.

- The overall shape of the long-run average cost curve depends on the technology of production.

- For example, advantages implicit in large scale production (with large plants) may allow firms to produce large outputs at lower cost per unit.

- On the other hand, firms may get so big that ever increasing managerial and monitoring costs may cause unit costs to rise.

ECONOMIES OF SCALE: When output increases, long-run average costs decline.

$/Q

LRAC shows economies of scale here.

LRAC

Q
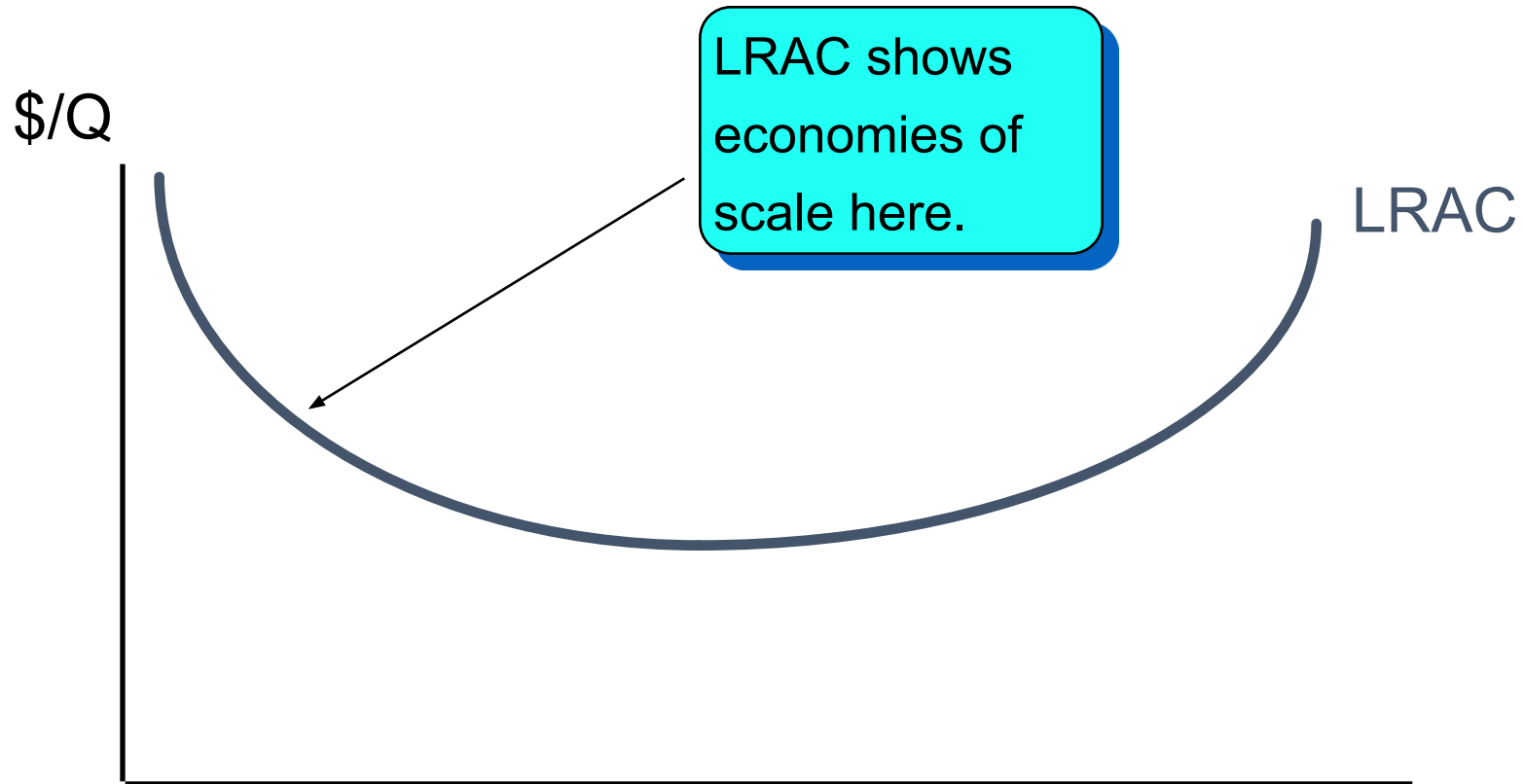
Average costs for a typical pizza firm.

DISECONOMIES OF SCALE: When output increases, long-run average costs increase.

$/Q

LRAC shows diseconomies of scale here.

LRAC

Average costs for a typical pizza firm.

Q
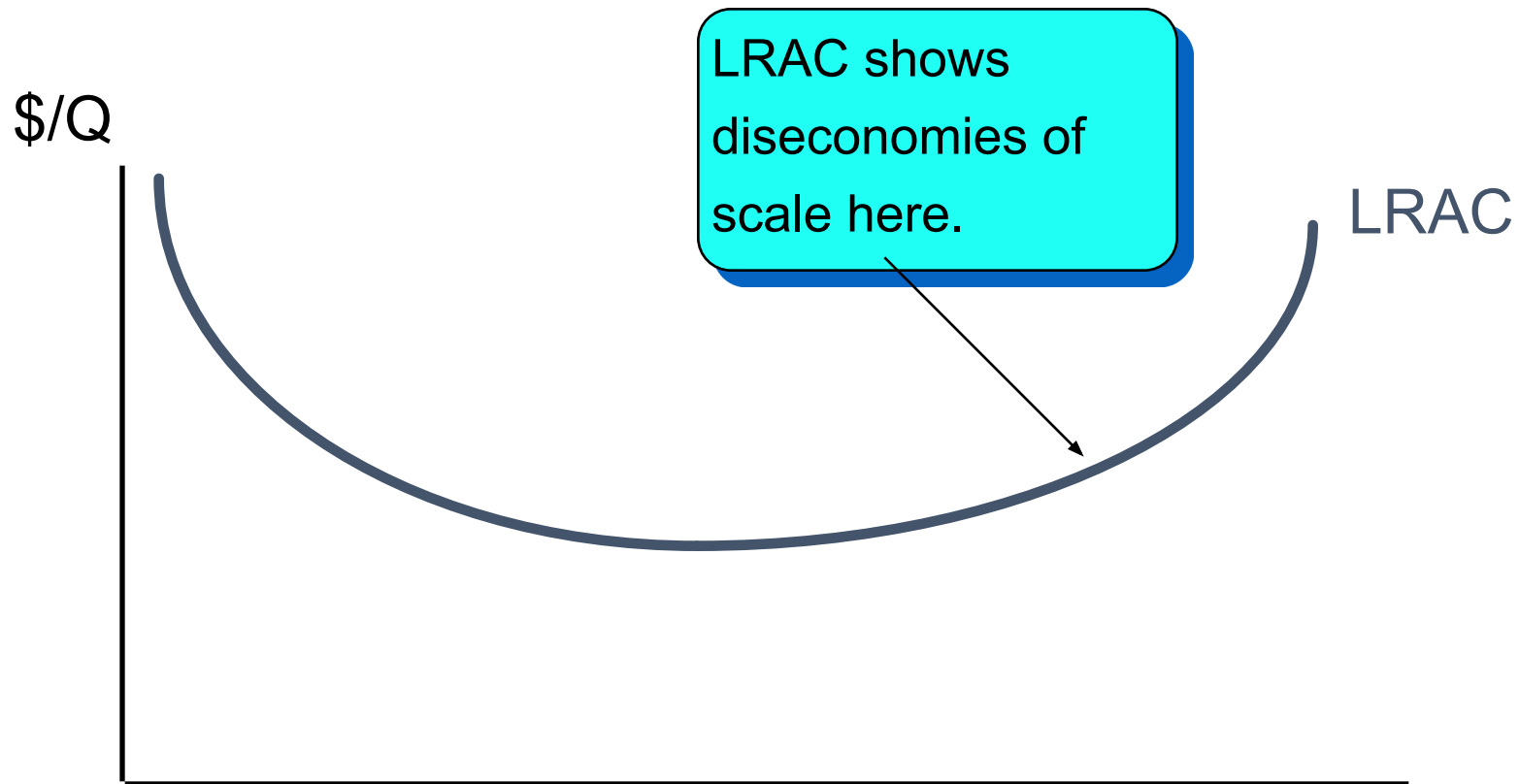
- For the U-shaped long-run average cost curve, there are economies of scale over small outputs, and diseconomies of scale at larger outputs.

- Not all firms necessarily suffer from diseconomies of scale at large outputs.

- When a firm has economies of scale over a range of outputs big enough to supply the total market demand, that firm is called a <u>natural monopoly.</u>

- Naturally monopolies have long-run average cost curves that look like this:

$/Q

LRAC

Q
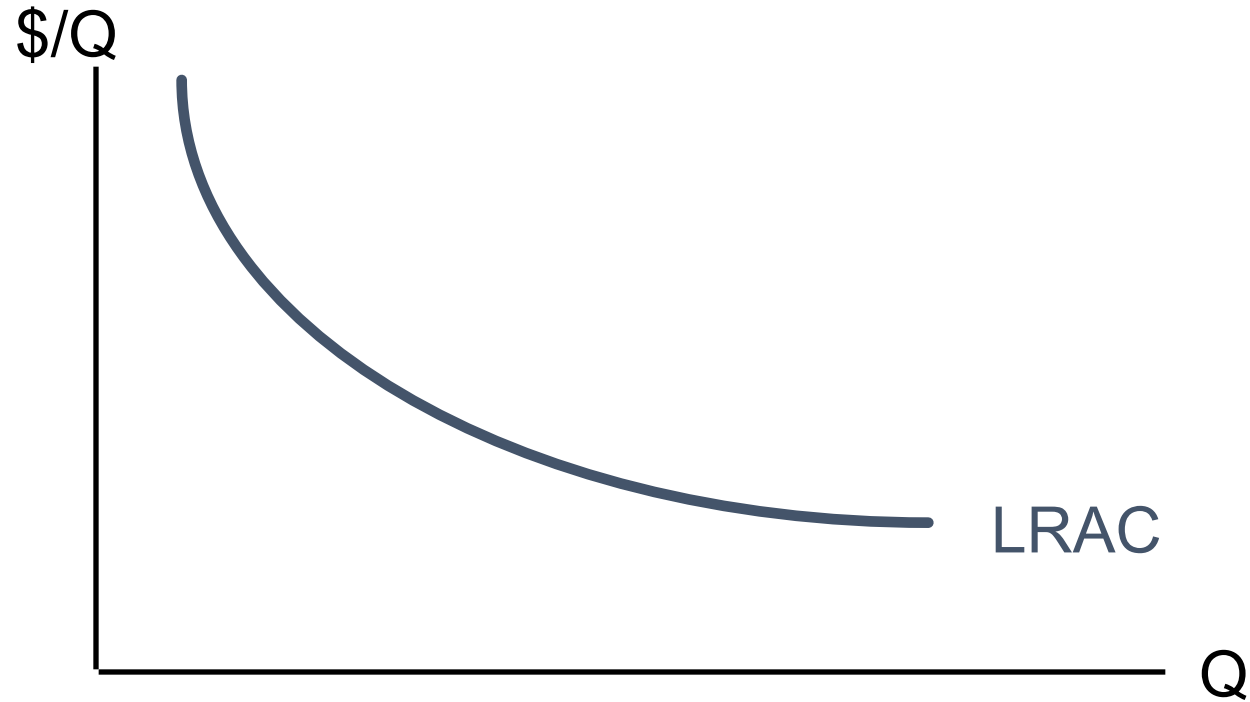
Electric power generation
in a local market

- As we will see, firms in perfect competition must have U-shaped long-run average cost curves.

- One conclusion from this is that only certain industries can be expected to be perfectly competitive. And a crucial factor is the technology of production, since that is what determines the shape of the long-run average cost curve.