Chapter 13

The Costs of Production

What are Costs?

- Industrial organization
  - The study of how firms' decisions about prices and quantities depend on the market conditions they face
- Assumption
  - The goal of a firm is to maximize profit
- Profit
  - Total revenue minus total cost

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
  - Explicit costs
  - Implicit costs

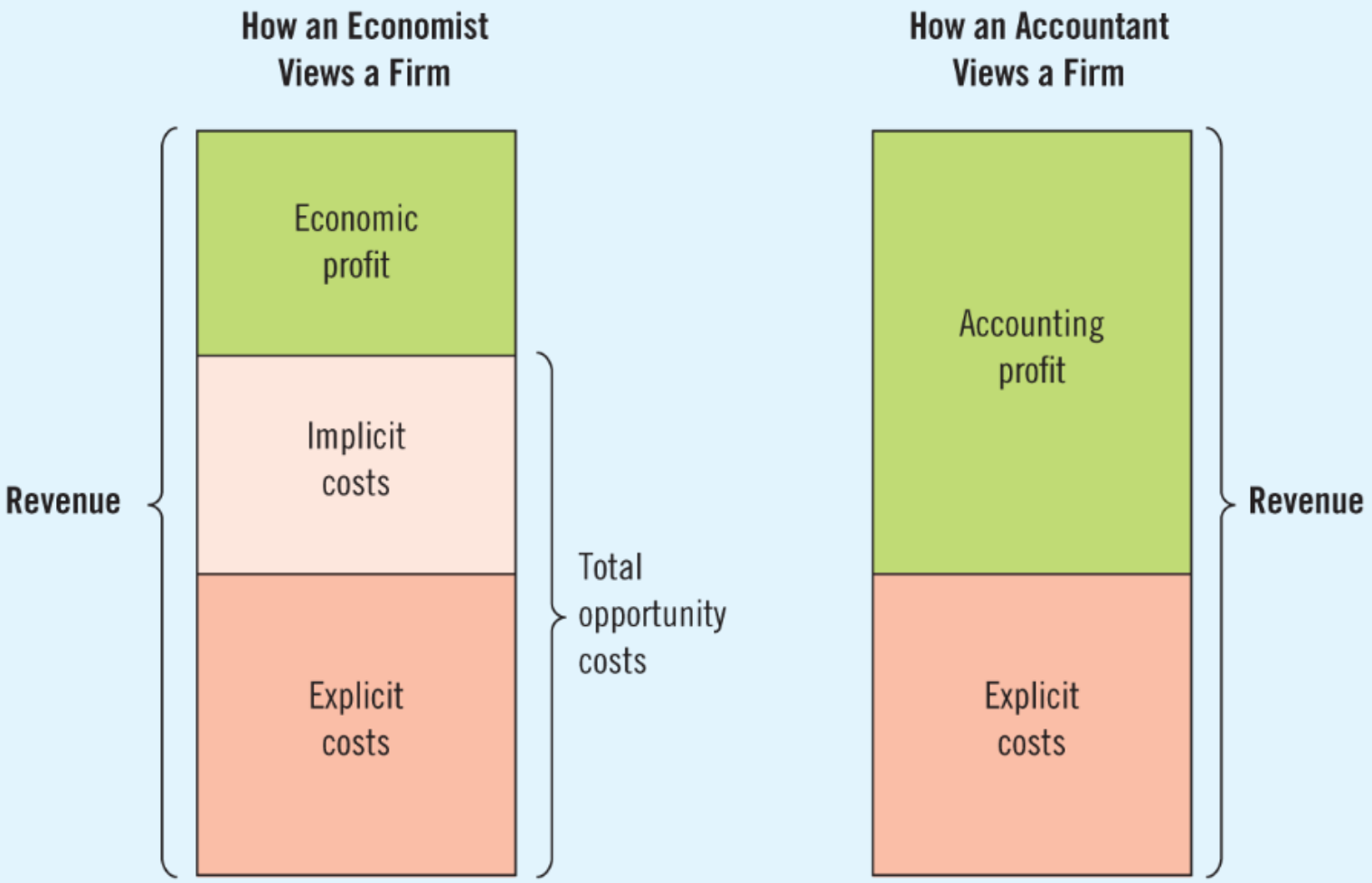
What are Costs?

- 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

Figure 1 Economists versus Accountants



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
- Marginal product
  - Increase in output that arises from an additional unit of input
  - Slope of the production function

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

(1) Number of Workers	(2) Output (quantity of cookies produced per hour)	(3) Marginal Product of Labor	(4) Cost of Factory	(5) Cost of Workers	(6) Total Cost of Inputs (cost of factory plus cost of workers)
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
6	155	5	30	60	90

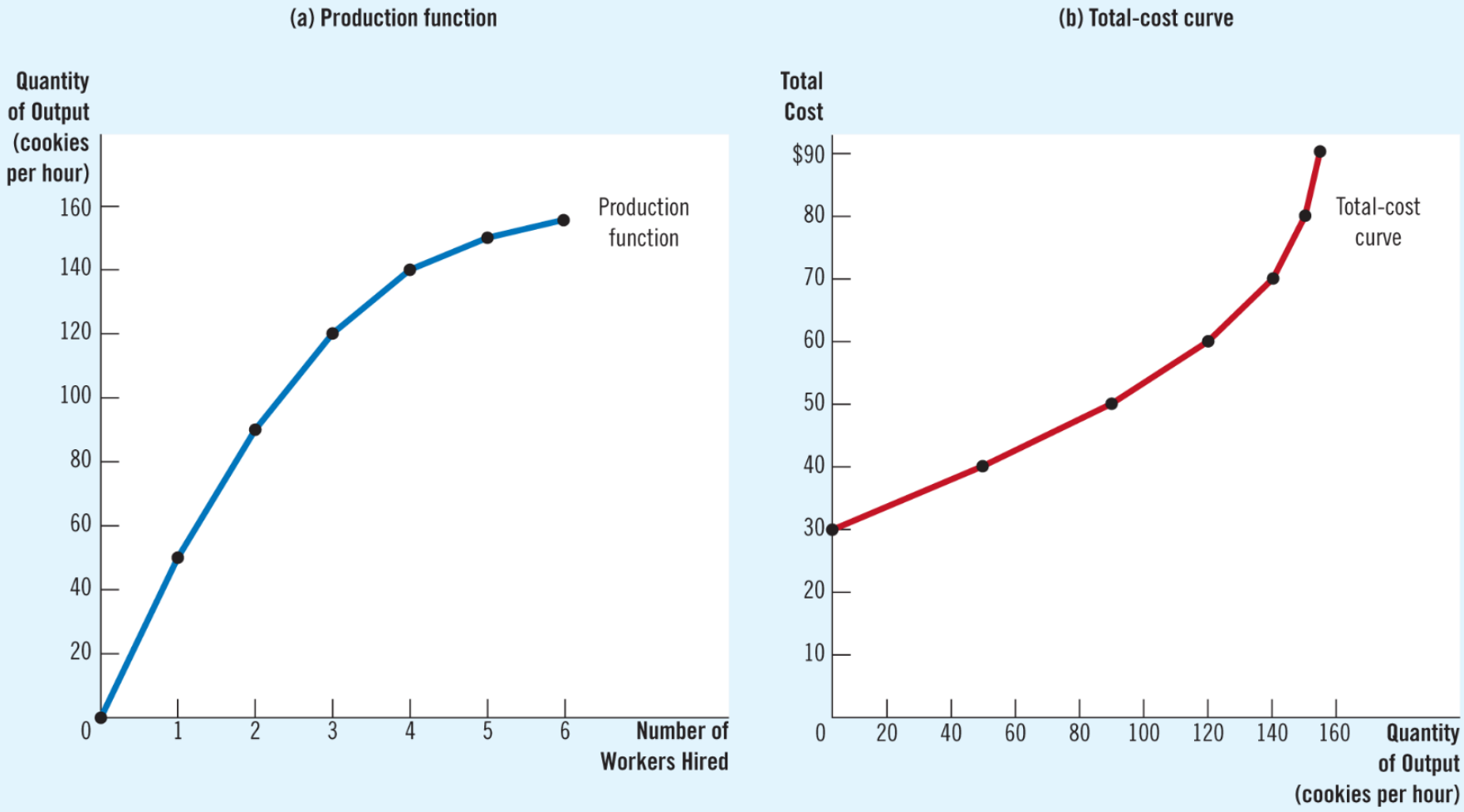
Production and Costs

- 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
  - The slope of the production function decreases

Production and Costs

- 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

Figure 2 Chloe's Production Function and Total-Cost Curve



The Various Measures of Cost

- Fixed costs, FC
  - Costs that do not vary with the quantity of output produced
- Variable costs, VC
  - Costs that vary with the quantity of output produced
- Total cost, TC

  = Fixed cost + Variable cost

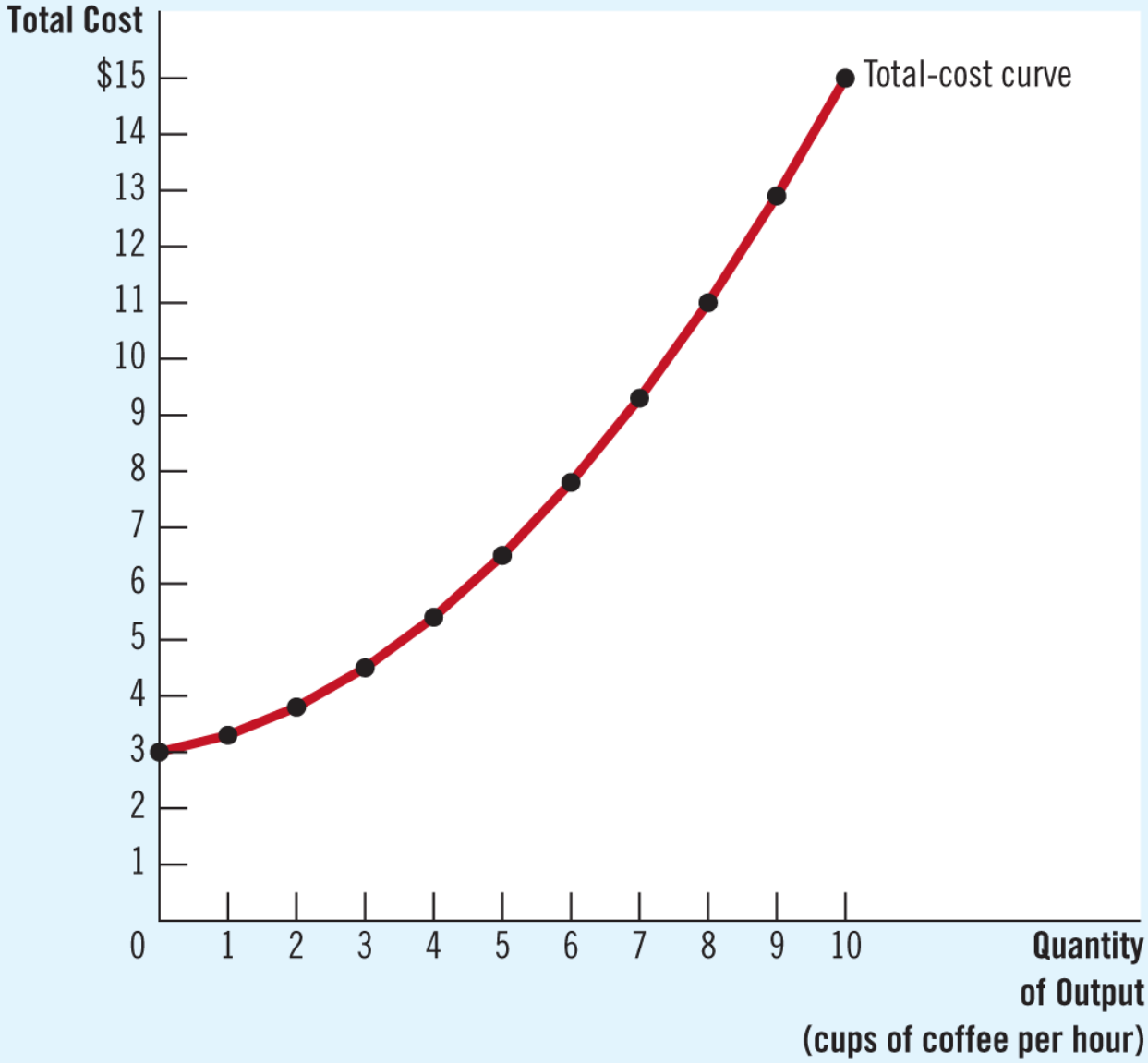
The Various Measures of Cost

- Average fixed cost, AFC
  - Fixed cost divided by the quantity of output
- Average variable cost, AVC
  - Variable cost divided by the quantity of output

Table 2 The Various Measures of Cost: Caleb's Coffee Shop

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

Figure 3 Caleb's Total-Cost Curve



The Various Measures of Cost

- Average total cost, ATC
  - Total cost divided by the quantity of output
  - ATC = TC / Q
- Marginal cost, MC
  - Increase in total cost arising from an extra unit of production

The Various Measures of Cost

- U-shaped average total cost curve
  - ATC = AVC + AFC
  - AFC – always declines as output rises
  - AVC – typically rises as output increases
    - Because of diminishing marginal product
  - The bottom of the U-shape
    - At quantity that minimizes average total cost

The Various Measures of Cost

- Efficient scale
  - Quantity of output that minimizes ATC
- Relationship between MC and ATC
  - When MC < ATC: average total cost is falling
  - When MC > ATC: average total cost is rising
  - The marginal-cost curve crosses the average-total-cost curve at its minimum

Figure 4 Caleb's Average-Cost and Marginal-Cost Curves

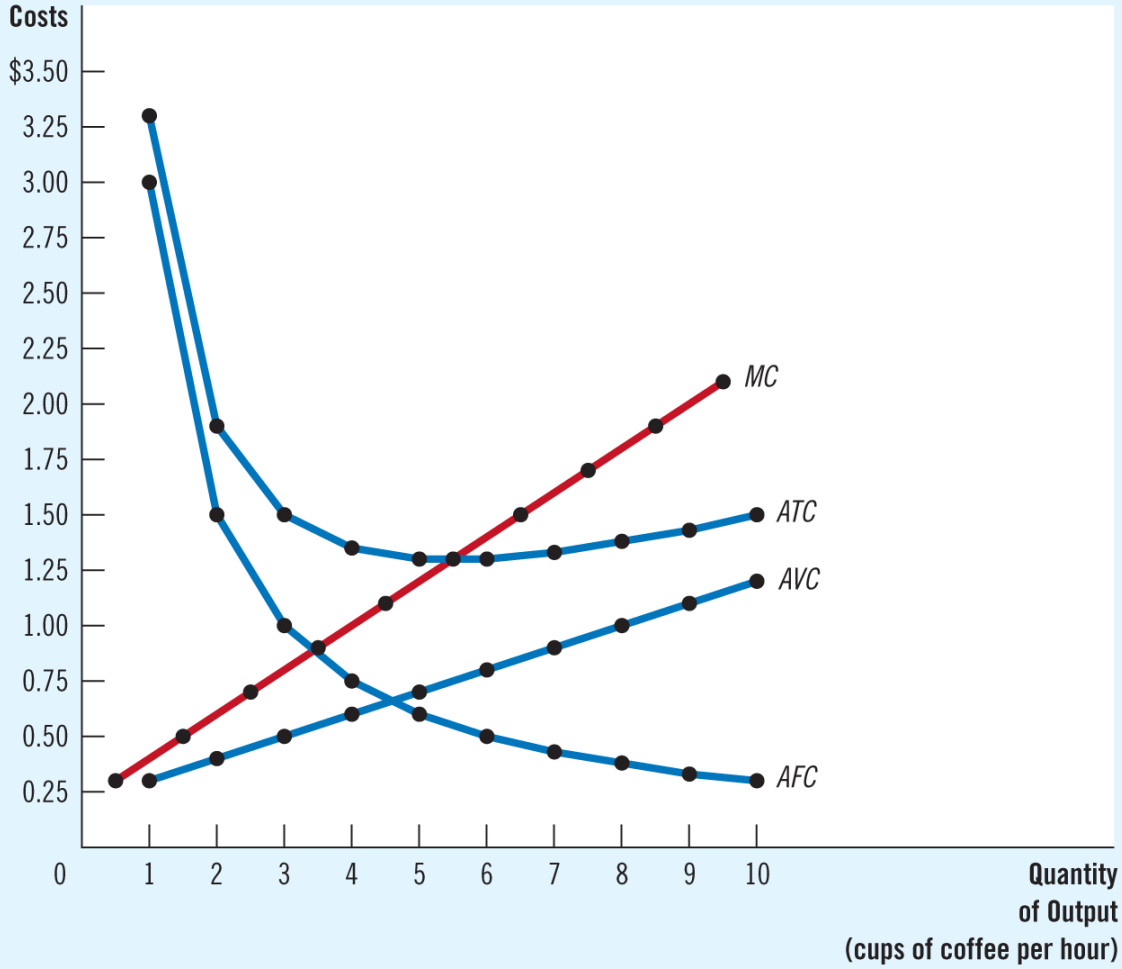


FIGURE 4

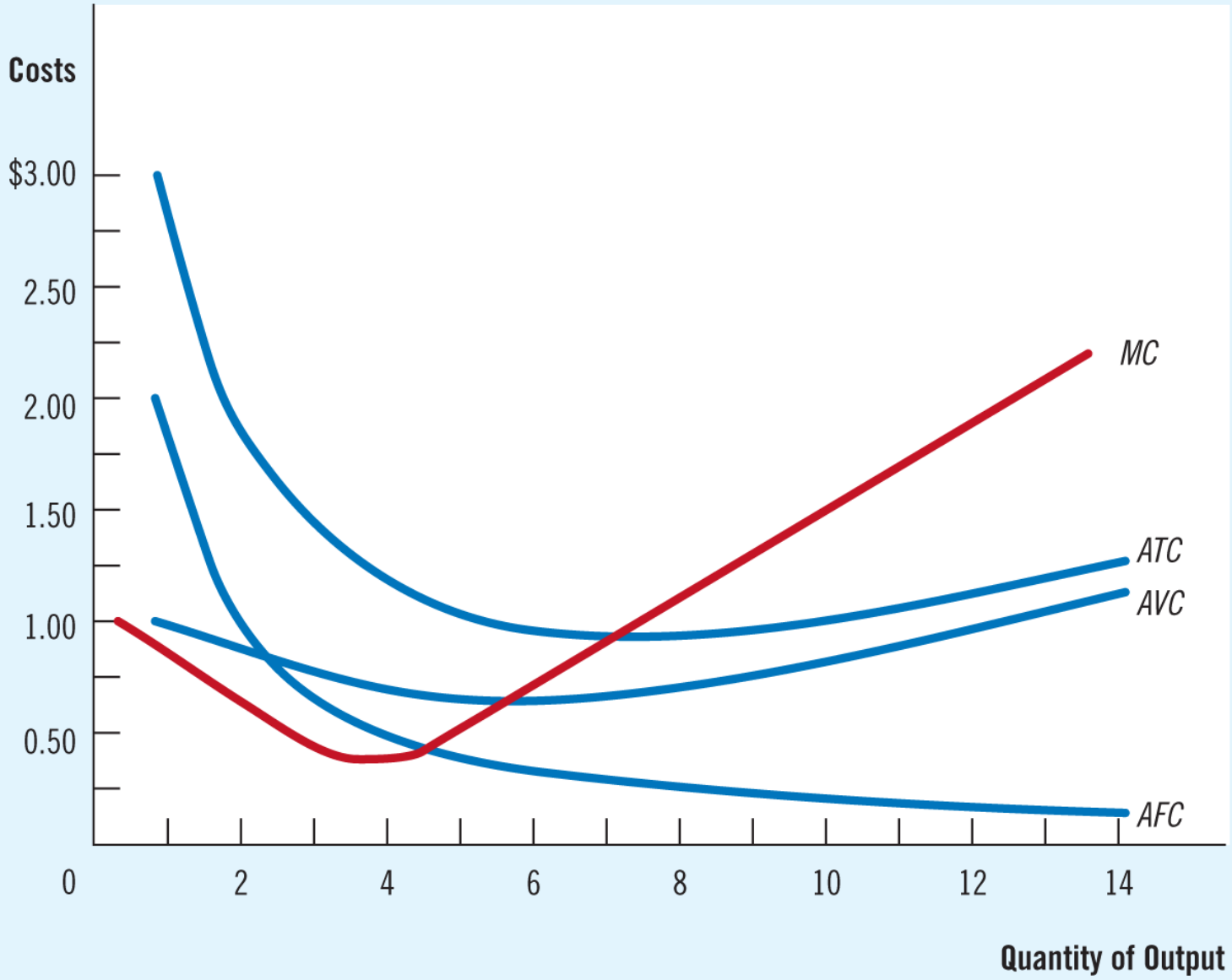
Caleb's Average-Cost and Marginal-Cost Curves

This figure shows the average total cost (*ATC*), average fixed cost (*AFC*), average variable cost (*AVC*), and marginal cost (*MC*) for Caleb's Coffee Shop. All of these curves are obtained by graphing the data in Table 2. These cost curves show three common features: (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.

The Various Measures of Cost

- Typical cost curves (summary)
  - Marginal cost eventually rises with the quantity of output
  - Average-total-cost curve is U-shaped
  - Marginal-cost curve crosses the average-total-cost curve at the minimum of average total cost

Figure 5 Cost Curves for a Typical Firm



Example

Quantity (Pairs)	Total Cost (Dollars)	Marginal Cost (Dollars)	Fixed Cost (Dollars)	Variable Cost (Dollars)	Average Variable Cost (Dollars per pair)	Average Total Cost (Dollars per pair)
0	60				—	—
1	155					
2	220					
3	255					
4	300					
5	350					
6	450					

Example

Quantity (Pairs)	Total Cost (Dollars)	Marginal Cost (Dollars)	Fixed Cost (Dollars)	Variable Cost (Dollars)	Average Variable Cost (Dollars per pair)	Average Total Cost (Dollars per pair)
0	60		60	0	—	—
1	155	95	60	95	95	155
2	220	65	60	160	80	110
3	255	35	60	195	65	85
4	300	45	60	240	60	75
5	350	50	60	290	58	70
6	450	100	60	390	65	75

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

Figure 6 Average Total Cost in Short & Long Runs

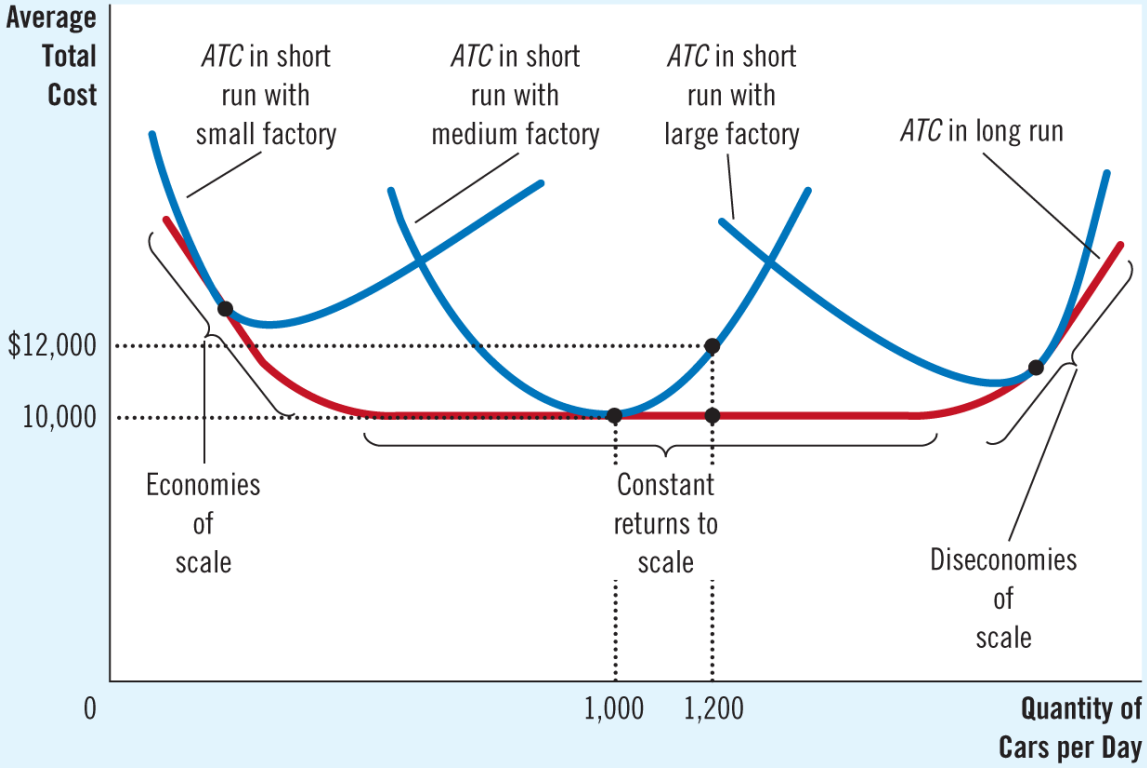


FIGURE 6

Average Total Cost in the Short and Long Runs

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.

Costs in Short and Long Run

- Economies of scale
  - Long-run average total cost falls as the quantity of output increases
- Constant returns to scale
  - Long-run average total cost stays the same as the quantity of output changes
- Diseconomies of scale
  - Long-run average total cost rises as the quantity of output increases

Table 3 The Many Types of Cost: A Summary

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