

- A firm's total costs can be divided between fixed costs and variable costs. Fixed costs are costs that do not change when the firm alters the quantity of output produced. Variable costs are costs that change when the firm alters the quantity of output produced.
- From a firm's total cost, two related measures of cost are derived. Average total cost is total cost divided by the quantity of output. Marginal cost is the amount by which total cost rises if output increases by 1 unit.
- When analyzing firm behavior, it is often useful to graph average total cost and marginal cost. For a typical firm, marginal cost rises with the quantity of output. Average total cost first falls as output increases and then rises as output increases further. The marginal-cost curve always crosses the average-total-cost curve at the minimum of average total cost.
- A firm's costs often depend on the time horizon considered. In particular, many costs are fixed in the short run but variable in the long run. As a result, when the firm changes its level of production, average total cost may rise more in the short run than in the long run.

KEY CONCEPTS

total revenue, p. 260

total cost, p. 260

profit, p. 260

explicit costs, p. 261

implicit costs, p. 261

economic profit, p. 262

accounting profit, p. 262

production function, p. 263

marginal product, p. 264

diminishing marginal

product, p. 265

fixed costs, p. 266

variable costs, p. 266

average total cost, p. 267

average fixed cost, p. 268

average variable cost, p. 268

marginal cost, p. 268

efficient scale, p. 270

economies of scale, p. 272

diseconomies of scale, p. 272

constant returns to scale, p. 273

QUESTIONS FOR REVIEW

1. Give an example of an opportunity cost that an accountant might not count as a cost. Why would the accountant ignore this cost?
2. What is the relationship between a firm's total revenue, profit, and total cost?
3. Draw a production function that exhibits diminishing marginal product of labor. Draw the associated total-cost curve. (In both cases, be sure to label the axes.) Explain the shapes of the two curves you have drawn.
4. What is marginal product, and what does it mean if it is diminishing?
5. Draw the marginal-cost and average-total-cost curves for a typical firm. Explain why the curves have the shapes that they do and why they cross where they do.
6. Define *total cost*, *average total cost*, and *marginal cost*. How are they related?
7. Define *economies of scale* and explain why they might arise. Define *diseconomies of scale* and explain why they might arise.
8. How and why does a firm's average-total-cost curve differ in the short run and in the long run?

PROBLEMS AND APPLICATIONS

1. Your aunt is thinking about opening a hardware store. She estimates that it would cost \$500,000 per year to rent the location and buy the stock. In addition, she would have to quit her \$50,000 per year job as an accountant.
 - a. Define *opportunity cost*.
 - b. What is your aunt's opportunity cost of running a hardware store for a year? If your aunt thought she could sell \$510,000 worth of merchandise in a year, should she open the store? Explain.
2. This chapter discusses many types of costs: opportunity cost, total cost, fixed cost, variable cost, average total cost, and marginal cost. Fill in the type of cost that best completes each sentence:
 - a. What you give up for taking some action is called the _____.

- b. _____ is falling when marginal cost is below it and rising when marginal cost is above it.
 - c. A cost that does not depend on the quantity produced is a(n) _____.
 - d. In the ice-cream industry in the short run, _____ includes the cost of cream and sugar but not the cost of the factory.
 - e. Profits equal total revenue less _____.
 - f. The cost of producing an extra unit of output is the _____.
3. Nimbus, Inc., makes brooms and then sells them door-to-door. Here is the relationship between the number of workers and Nimbus's output in a given day:

Workers	Output	Marginal Product	Total Cost	Average Total Cost	Marginal Cost
0	0	—	—	—	—
1	20	—	—	—	—
2	50	—	—	—	—
3	90	—	—	—	—
4	120	—	—	—	—
5	140	—	—	—	—
6	150	—	—	—	—
7	155	—	—	—	—

- a. Fill in the column of marginal products. What pattern do you see? How might you explain it?
 - b. A worker costs \$100 a day, and the firm has fixed costs of \$200. Use this information to fill in the column for total cost.
 - c. Fill in the column for average total cost. (Recall that $ATC = TC/Q$.) What pattern do you see?
 - d. Now fill in the column for marginal cost. (Recall that $MC = \Delta TC / \Delta Q$.) What pattern do you see?
 - e. Compare the column for marginal product and the column for marginal cost. Explain the relationship.
 - f. Compare the column for average total cost and the column for marginal cost. Explain the relationship.
4. A commercial fisherman notices the following relationship between hours spent fishing and the quantity of fish caught:

Hours	Quantity of Fish (in pounds)
0 hours	0 lb.
1	10
2	18
3	24
4	28
5	30

- a. What is the marginal product of each hour spent fishing?
 - b. Use these data to graph the fisherman's production function. Explain its shape.
 - c. The fisherman has a fixed cost of \$10 (his pole). The opportunity cost of his time is \$5 per hour. Graph the fisherman's total-cost curve. Explain its shape.
5. Consider the following cost information for a pizzeria:

Quantity	Total Cost	Variable Cost
0 dozen pizzas	\$300	\$ 0
1	350	50
2	390	90
3	420	120
4	450	150
5	490	190
6	540	240

- a. What is the pizzeria's fixed cost?
 - b. Construct a table in which you calculate the marginal cost per dozen pizzas using the information on total cost. Also, calculate the marginal cost per dozen pizzas using the information on variable cost. What is the relationship between these sets of numbers? Comment.
6. You are the chief financial officer for a firm that sells digital music players. Your firm has the following average-total-cost schedule:

Quantity	Average Total Cost
600 players	\$300
601	301

- Your current level of production is 600 devices, all of which have been sold. Someone calls, desperate to buy one of your music players. The caller offers you \$550 for it. Should you accept the offer? Why or why not?
7. Your cousin Vinnie owns a painting company with fixed costs of \$200 and the following schedule for variable costs:

Quantity of Houses Painted per Month	1	2	3	4	5	6	7
Variable Costs	\$10	\$20	\$40	\$80	\$160	\$320	\$640

Calculate average fixed cost, average variable cost, and average total cost for each quantity. What is the efficient scale of the painting company?

8. You are thinking about setting up a lemonade stand. The stand itself costs \$200. The ingredients for each cup of lemonade cost \$0.50.
 - a. What is your fixed cost of doing business? What is your variable cost per cup?
 - b. Construct a table showing your total cost, average total cost, and marginal cost for output levels varying from 0 to 10 gallons. (Hint: There are 16 cups in a gallon.) Draw the three cost curves.
9. The city government is considering two tax proposals:
 - A lump-sum tax of \$300 on each producer of hamburgers.
 - A tax of \$1 per burger, paid by producers of hamburgers.
 - a. Which of the following curves—average fixed cost, average variable cost, average total cost, and marginal cost—would shift as a result of the lump-sum tax? Why? Show this in a graph. Label the graph as precisely as possible.
 - b. Which of these same four curves would shift as a result of the per-burger tax? Why? Show this in a new graph. Label the graph as precisely as possible.
10. A firm uses two inputs in production: capital and labor. In the short run, the firm cannot adjust the amount of capital it is using, but it can adjust the size of its workforce. What happens to the firm's

average total cost curve, the average variable cost curve, and the marginal cost curve when

- a. the cost of renting capital increases?
- b. the cost of hiring labor increases?

11. Consider the following table of long-run total costs for three different firms:

Quantity	1	2	3	4	5	6	7
Firm A	\$60	\$70	\$80	\$90	\$100	\$110	\$120
Firm B	11	24	39	56	75	96	119
Firm C	21	34	49	66	85	106	129

Does each of these firms experience economies of scale or diseconomies of scale?

12. Jane's Juice Bar has the following cost schedules:

Quantity	Variable Cost	Total Cost
0 vats of juice	\$ 0	\$ 30
1	10	40
2	25	55
3	45	75
4	70	100
5	100	130
6	135	165

- a. Calculate average variable cost, average total cost, and marginal cost for each quantity.
- b. Graph all three curves. What is the relationship between the marginal-cost curve and the average-total-cost curve? Between the marginal-cost curve and the average-variable-cost curve? Explain.

For further information on topics in this chapter, additional problems, applications, examples, online quizzes, and more, please visit our website at www.cengage.com/international.