

ANSWERS TO END-OF-CHAPTER QUESTIONS

- 20-1 Distinguish between explicit and implicit costs, giving examples of each. What are the explicit and implicit costs of attending college? Why does the economist classify normal profit as a cost? Is economic profit a cost of production?

Explicit costs are payments the firm must make for inputs to nonowners of the firm to attract them away from other employment, for example, wages and salaries to its employees. Implicit costs are nonexpenditure costs that occur through the use of self-owned, self-employed resources, for example, the salary the owner of a firm forgoes by operating his or her own firm and not working for someone else.

The explicit costs of going to college are the tuition costs, the cost of books, and the extra costs of living away from home (if applicable). The implicit costs are the income forgone and the hard grind of studying (if applicable).

Economists classify normal profits as costs, since in the long run the owner of a firm would close it down if a normal profit were not being earned. Since a normal profit is required to keep the entrepreneur operating the firm, a normal profit is a cost.

Economic profits are not costs of production since the entrepreneur does not require the gaining of an economic profit to keep the firm operating. In economics, costs are whatever is required to keep a firm operating.

- 20-2 (*Key Question*) Gomez runs a small pottery firm. He hires one helper at \$12,000 per year, pays annual rent of \$5,000 for his shop, and spends \$20,000 per year on materials. He has \$40,000 of his own funds invested in equipment (pottery wheels, kilns, and so forth) that could earn him \$4,000 per year if alternatively invested. He has been offered \$15,000 per year to work as a potter for a competitor. He estimates his entrepreneurial talents are worth \$3,000 per year. Total annual revenue from pottery sales is \$72,000. Calculate accounting profits and economic profits for Gomez's pottery.

Explicit costs: \$37,000 (= \$12,000 for the helper + \$5,000 of rent + \$20,000 of materials).
Implicit costs: \$22,000 (= \$4,000 of forgone interest + \$15,000 of forgone salary + \$3,000 of entrepreneurship).

Accounting profit = \$35,000 (= \$72,000 of revenue - \$37,000 of explicit costs); Economic profit = \$13,000 (= \$72,000 - \$37,000 of explicit costs - \$22,000 of implicit costs).

- 20-3 Which of the following are short-run and which are long-run adjustments? (a) Wendy's builds a new restaurant; (b) Acme Steel Corporation hires 200 more production workers; (c) A farmer increases the amount of fertilizer used on his corn crop; and (d) An Alcoa plant adds a third shift of workers.

(a) Long-run, (b) Short-run, (c) Short-run, (d) Short-run

- 20-4 (*Key Question*) Complete the following table by calculating marginal product and average product from the data given. Plot total, marginal, and average product and explain in detail the relationship between each pair of curves. Explain why marginal product first rises, then declines, and ultimately becomes negative. What bearing does the law of diminishing returns have on short-run costs? Be specific. "When marginal product is rising, marginal cost is falling. And when marginal product is diminishing, marginal cost is rising." Illustrate and explain graphically.

Inputs labor	of Total product	Marginal product	Average product
0	0	—	—
1	15	—	—
2	34	—	—
3	51	—	—
4	65	—	—
5	74	—	—
6	80	—	—
7	83	—	—
8	82	—	—

Marginal product data, top to bottom: 15; 19; 17; 14; 9; 6; 3; -1. Average product data, top to bottom: 15; 17; 17; 16.25; 14.8; 13.33; 11.86; 10.25. Your diagram should have the same general characteristics as text Figure 22-2.

MP is the slope—the rate of change—of the TP curve. When TP is rising at an increasing rate, MP is positive and rising. When TP is rising at a diminishing rate, MP is positive but falling. When TP is falling, MP is negative and falling. AP rises when MP is above it; AP falls when MP is below it.

MP first rises because the fixed capital gets used more productively as added workers are employed. Each added worker contributes more to output than the previous worker because the firm is better able to use its fixed plant and equipment. As still more labor is added, the law of diminishing returns takes hold. Labor becomes so abundant relative to the fixed capital that congestion occurs and marginal product falls. At the extreme, the addition of labor so overcrowds the plant that the marginal product of still more labor is negative—total output falls.

Illustrated by Figure 20.6. Because labor is the only variable input and its price (its wage rate) is constant, MC is found by dividing the wage rate by MP. When MP is rising, MC is falling; when MP reaches its maximum, MC is at its minimum; when MP is falling, MC is rising.

- 20-5 Why can the distinction between fixed and variable costs be made in the short run? Classify the following as fixed or variable costs: advertising expenditures, fuel, interest on company-issued bonds, shipping charges, payments for raw materials, real estate taxes, executive salaries, insurance premiums, wage payments, depreciation and obsolescence charges, sales taxes, and rental payments on leased office machinery. “There are no fixed costs in the long run; all costs are variable.” Explain.

The distinction can be made because there are some costs that do not vary with total output. These are the fixed costs that, fundamentally, are related to the scale or size of the plant. In the short run, by definition, the scale of the plant cannot change: The firm cannot bring in more machinery or move to a larger building. All costs that are related to the scale of the plant—costs that continue to be incurred even though the firm’s output may be zero—are fixed costs. On the other hand, the firm can increase its output by using its plant—its fixed capital—more intensively, that is, by hiring more labor, or by using more materials. But by doing so, it will increase its operating costs, its variable costs.

Advertising expenditures: variable costs (although it may be reasonable to argue a fixed component). Fuel: variable costs. Interest on company-issued bonds: fixed costs. Shipping charges: variable costs. Payments for raw materials: variable costs. Real estate taxes: fixed costs. Executive salaries: fixed costs. Insurance premiums: fixed costs. Wage payments: variable costs.

Depreciation and obsolescence charges: fixed costs. Sales taxes: variable costs. Rental payments on leased office machinery: fixed costs (although it is possible that short-term lease arrangements on some types of office equipment may rise or fall with output).

In the long run, the firm can, by definition, get out of paying all of its short-run fixed costs; its lease is up, it can fire its executives without penalty, the insurance has run out, and so on. All of its costs at this moment, then, are variable. It can decide to continue producing at the same scale and thus reassume all its previous fixed costs for the next short-run period; or it can decide to increase its scale and thus increase its fixed costs; or it can decide to go out of business and thus have no costs at all.

- 20-6 List several fixed and variable costs associated with owning and operating an automobile. Suppose you are considering whether to drive your car or fly 1,000 miles to Florida for spring break. Which costs—fixed, variable, or both—would you take into account in making your decision? Would any implicit costs be relevant? Explain.

Fixed costs associated with owning and operating an automobile include the price of the car (probably monthly payments); insurance; driver's license; car license; and depreciation.

Variable costs associated with owning and operating an automobile include gasoline, oil, lubricants; repairs; car wash; and depreciation, which is also in part a variable cost since the more the car is driven, the more it depreciates.

The costs of driving to Fort Lauderdale are the same variable costs (including depreciation) listed above. Going by plane, the variable cost is the cost of the ticket. It would probably be cheaper to drive but this would leave out the relevant implicit cost—my time and the wear and tear on myself of driving there and back. The plane would be faster. How much is it worth to me to arrive sooner and stay longer and be fresher on arrival? On the other hand, maybe I'd find the car useful around Fort Lauderdale, and having one's own car saves the variable cost of renting if one flies.

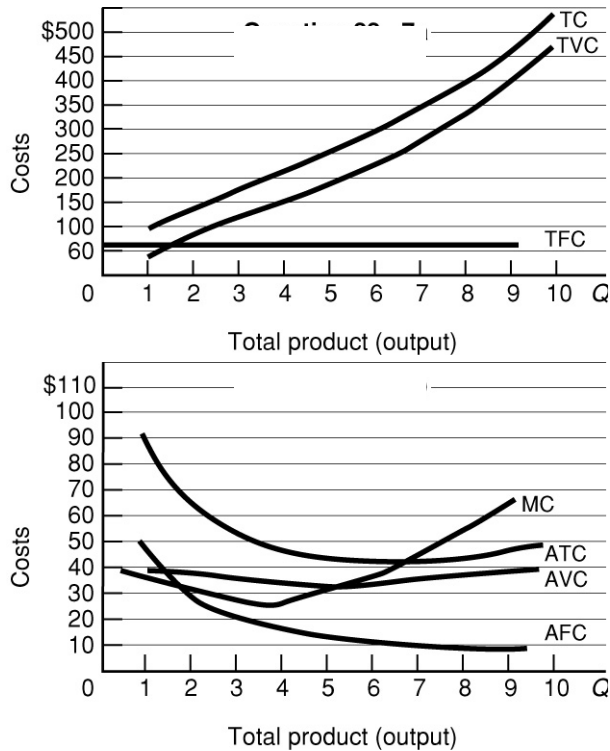
- 20-7 (Key Question) A firm has fixed costs of \$60 and variable costs as indicated in the table below. Complete the table. When finished, check your calculations by referring to question 4 at the end of Chapter 21.

Total product	Total fixed cost	Total variable cost	Total cost	Average fixed cost	Average variable cost	Average total cost	Marginal cost
0	\$ ____	\$ 0	\$ ____				
1	____	45	____	\$ ____	\$ ____	\$ ____	\$ ____
2	____	85	____	____	____	____	____
3	____	120	____	____	____	____	____
4	____	150	____	____	____	____	____
5	____	185	____	____	____	____	____
6	____	225	____	____	____	____	____
7	____	270	____	____	____	____	____
8	____	325	____	____	____	____	____
9	____	390	____	____	____	____	____
10	____	465	____	____	____	____	____

- Graph total fixed cost, total variable cost, and total cost. Explain how the law of diminishing returns influences the shapes of the total variable-cost and total-cost curves.
- Graph AFC, AVC, ATC, and MC. Explain the derivation and shape of each of these four curves and their relationships to one another. Specifically, explain in nontechnical terms why the MC curve intersects both the AVC and ATC curves at their minimum points.
- Explain how the locations of each of the four curves graphed in question 7b would be altered if (1) total fixed cost had been \$100 rather than \$60, and (2) total variable cost had been \$10 less at each level of output.

The total fixed costs are all \$60. The total costs are all \$60 more than the total variable cost. The other columns are shown in Question 4 in Chapter 21.

- See the graph. Over the 0 to 4 range of output, the TVC and TC curves slope upward at a decreasing rate because of increasing marginal returns. The slopes of the curves then increase at an increasing rate as diminishing marginal returns occur.
- See the graph. $AFC (= TFC/Q)$ falls continuously since a fixed amount of capital cost is spread over more units of output. The $MC (= \text{change in } TC/\text{change in } Q)$, $AVC (= TVC/Q)$, and $ATC (= TC/Q)$ curves are U-shaped, reflecting the influence of first increasing and then diminishing returns. The ATC curve sums AFC and AVC vertically. The ATC curve falls when the MC curve is below it; the ATC curve rises when the MC curve is above it. This means the MC curve must intersect the ATC curve at its lowest point. The same logic holds for the minimum point of the AVC curve.

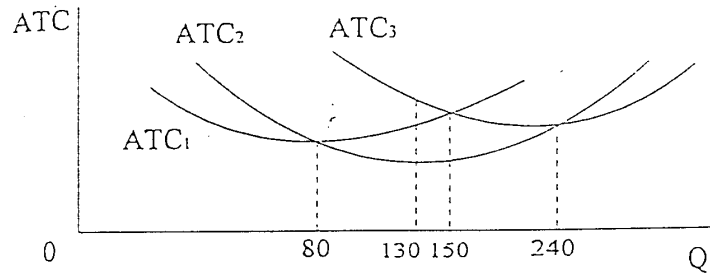


- (c1) If TFC has been \$100 instead of \$60, the AFC and ATC curves would be higher—by an amount equal to \$40 divided by the specific output. Example: at 4 units, $AVC = \$25.00 [= (\$60 + \$40)/4]$; and $ATC = \$62.50 [= (\$210 + \$40)/4]$. The AVC and MC curves are not affected by changes in fixed costs.
- (c2) If TVC has been \$10 less at each output, MC would be \$10 lower for the first unit of output but remain the same for the remaining output. The AVC and ATC curves would also be lower—by an amount equal to \$10 divided by the specific output. Example: at 4 units of output, $AVC = \$35.00 [= (\$150 - \$10)/4]$, $ATC = \$50 [= (\$210 - \$10)/4]$. The AFC curve would not be affected by the change in variable costs.

20-8 Indicate how each of the following would shift the (a) marginal-cost curve, (b) average-variable cost curve, (c) average-fixed-cost curve, and (d) average-total-cost curve of a manufacturing firm. In each case specify the direction of the shift.

- A reduction in business property taxes
 - An increase in the nominal wages of production workers
 - A decrease in the price of electricity
 - An increase in insurance rates on plant and equipment
 - An increase in transportation costs
- MC no change; AVC no change; AFC shift down; ATC shift down.
 - MC shift up; AVC shift up; AFC no change; ATC shift up.
 - MC shift down; AVC shift down; AFC no change; ATC shift down.
 - MC no change; AVC no change; AFC shift up; ATC shift up.
 - MC shift up; AVC shift up; AFC no change; ATC shift up.

- 20-9 Suppose a firm has only three possible plant-size options represented by the ATC curves shown in the accompanying figure. What plant size will the firm choose in producing (a) 50, (b) 130, (c) 160, and (d) 250 units of output? Draw the firm's long-run average-cost curve on the diagram and describe this curve.



- (a) To produce 50 units, the firm will choose plant size #1, since its ATC is lower for this size firm in producing less than 80 units.
- (b) To produce 130 units, the firm will choose plant size #2, since its ATC is lower for size #2 in producing between 80 and 240 units.
- (c) To produce 160 units, the firm will choose plant size #2, since its ATC is lowest for producing between 80 and 240 units.
- (d) To produce 250 units, the firm will choose plant size #3, since its ATC is lowest for production of more than 240 units.

The long-run average-cost curve drawn on this diagram would trace ATC_1 as far as 80 units, then ATC_2 between 80 and 240 units, then finally trace ATC_3 from 240 units to the end of the graph. Students could reproduce the graph in the text and then use a heavy line or different color to show this tracing.

- 20-10 (Key Question) Use the concepts of economies and diseconomies of scale to explain the shape of a firm's long-run ATC curve. What is the concept of minimum efficient scale? What bearing may the exact shape of the long-run ATC curve have on the structure of an industry?

The long-run ATC curve is U-shaped. At first, long-run ATC falls as the firm expands and realizes economies of scale from labor and managerial specialization and the use of more efficient capital. The long-run ATC curve later turns upward when the enlarged firm experiences diseconomies of scale, usually resulting from managerial inefficiencies.

The MES (minimum efficient scale) is the smallest level of output needed to attain all economies of scale and minimum long-run ATC.

If long-run ATC drops quickly to its minimum cost which then extends over a long range of output, the industry will likely be composed of both large and small firms. If long-run ATC descends slowly to its minimum cost over a long range of output, the industry will likely be composed of a few large firms. If long-run ATC drops quickly to its minimum point and then rises abruptly, the industry will likely be composed of many small firms.

- 20-11 (*Last Word*) What is a sunk cost? Provide an example of a sunk cost other than one from this book. Why are such costs irrelevant in making decisions about future actions?

A sunk cost is one that cannot be partly or fully recouped by some choice. A person buys a ticket for a cruise and finds out that a hurricane is headed toward the Caribbean. A rational consumer or firm should ignore the fact that they've already paid for the ticket. Economic analysis says that you should not take actions for which the marginal cost exceeds the marginal benefit. A firm that has spent millions of dollars developing a new product that bombs, will not improve their situation by losing still more money in additional production.