

Chapter 10

- I. One year ago, Jack and Jill set up a vinegar-bottling firm (called JJVB). Use the following data to calculate JJVB's opportunity cost of production during its first year of operation:
- Jack and Jill put \$50,000 of their own money into the firm and bought equipment for \$30,000.
 - They hired one worker at \$20,000 a year.
 - Jack quit his old job, which paid \$30,000 a year worked full-time for JJVB.
 - Jill kept her old job, which paid \$30 an hour, but gave up 500 hours of leisure a year to work for JJVB.
 - JJVB bought \$10,000 of goods and services.
 - The market value of the equipment at the end of the year was \$28,000.
 - Jack and Jill have a \$100,000 home loan on which they pay interest of 6 percent a year.

The wages paid, \$20,000, and the goods and services bought from other firms, \$10,000, are opportunity costs to JJVB. Other opportunity costs include the interest forgone on the \$50,000 put into the firm, which could have been used to pay part of the mortgage, so the interest forgone is \$3,000; the \$30,000 income forgone by Jack not working at his previous job; \$15,000, which is the value of 500 hours of Jill's leisure; and the economic depreciation of \$2,000 (\$30,000 minus \$28,000). JJVB's total opportunity cost is the sum of all these opportunity costs and is \$80,000.

2. Joe, who has no skills, no job experience, and no alternative employment, runs a shoeshine stand. Other operators of shoeshine stands earn \$10,000 a year. Joe pays rent of \$2,000 a year, and his total revenue is \$15,000 a year. Joe spent \$1,000 on equipment, which he used his credit card to buy. The interest on a credit card balance is 20 percent a year. At the end of the year, Joe was offered \$500 for his business and all its equipment. Calculate Joe's opportunity cost of production and his economic profit.

Joe's opportunity costs are the \$2,000 paid to the airport for the space; the \$200 for the interest paid on the \$1,000 credit card balance; the \$10,000 of normal profit; and, the \$500 for the depreciation of his equipment (which equals the \$1,000 paid for the chair, polish, and brushes minus the \$500 he was offered for this equipment). Joe's total opportunity cost is the sum of these costs, which is \$12,700. Joe's economic profit is his total revenue, \$15,000, minus his total opportunity cost, \$12,700, for an economic profit of \$2,300.

3. Four ways of laundering 100 shirts are in the table.

- a. Which methods are technologically efficient?

All the methods are technologically efficient.

- b. Which method is economically efficient if the hourly wage rate and the implicit rental rate of capital are:

- (i) Wage rate \$1, rental rate \$100?

Method D is economically efficient because the total cost is the least. Method D's costs are $50 \times \$1 + 1 \times \100 , or \$150.

- (ii) Wage rate \$5, rental rate \$50?

Method D and Method C are economically efficient because the total cost is the least. Method C's costs are $20 \times \$5 + 4 \times \50 , or \$300 and Method D's costs are $50 \times \$5 + 1 \times \50 , also \$300.

- (iii) Wage rate \$50, rental rate \$5?

Method A is economically efficient because the total cost is the least. Method A's costs are $1 \times \$50 + 10 \times \5 , or \$100.

Method	Labor (hours)	Capital (machines)
A	1	10
B	5	8
C	20	4
D	50	1

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5. Sales of the firms in the tattoo industry are in the table. Calculate the four-firm concentration ratio. What is the structure of the tattoo industry?

The four-firm concentration ratio is 60.49. The four-firm concentration ratio equals the ratio of the total sales of the largest four firms to the total industry sales expressed as a percentage. The total sales of the largest four firms is \$450 + \$325 + \$250 + \$200, which equals \$1,225. Total industry sales equal \$1,225 + \$800, which equals \$2,025. The four-firm concentration ratio equals $(\$1,225/\$2,025) \times 100$, which is 60.49 percent.

This industry is highly concentrated because the four-firm concentration ratio exceeds 60 percent.

Firm	Sales (dollars per year)
Bright Spots	450
Freckles	325
Love Galore	250
Native Birds	200
Other 15 firms	800

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7. FedEx contracts with independent truck operators to pick up and deliver its packages and pays them on the volume of packages carried. Why doesn't FedEx buy more trucks and hire more drivers? What incentive problems might arise from this arrangement?

FedEx does not buy more trucks and hire more drivers because FedEx faces a principal-agent problem. In particular, it is not easy to monitor its drivers and insure that they are working hard to efficiently deliver packages. FedEx overcomes this problem by hiring independent contractors and then paying them based on the amount of packages they deliver. Essentially, FedEx uses a piecework method of payment.

FedEx pays its drivers based on the volume of packages they deliver. This method of payment creates a few incentive potential problems for FedEx. First, FedEx must worry about the quality of its service. In particular, unless FedEx bases part of the payment on quality, its drivers have an incentive to drop the package and race off to the next delivery with no concern for how the packages are handled. Second, FedEx must take care that drivers do not attempt to select only packages that are close to the FedEx location and avoid packages that have a greater than average driving time. Finally, FedEx also must worry that its drivers do not take undue risks while driving in order to deliver as many packages as possible. If FedEx trucks were involved in too many accidents, FedEx would suffer bad publicity and, presumably, would lose some business.

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10. In 2014, Homer was a salesperson and had an annual salary of \$8,000. He also earned \$1,500 by teaching Japanese. On January 1, 2015, he quit his job, stopped teaching, and rented a storefront to run a bookshop. He took \$6,000 from his savings account to buy bookshelves and other facilities. During 2015, he paid \$13,000 for rent and \$7,500 for hiring an employee. He received a total revenue from the bookshop of \$43,000 and earned interest at 5 percent a year on his savings account balance. Normal profit is \$52,000 a year. At the end of 2015, John could have sold his bookshelves and other facilities for \$2,800. Calculate John's opportunity cost of production and his economic profit in 2015.

John has costs of \$13,000 for the rent of the storefront; \$7,500 for hiring a staff; \$52,000 for normal profit; \$8,000 of forgone earnings from working as a salesperson; \$1,500 of forgone earnings from teaching; \$300 of forgone interest from her saving account; and \$3,200 for the depreciation of his facilities (which equals the \$6,000 paid for it minus the \$2,800 for which he could have sold it). These various costs sum to a total opportunity cost of \$85,500. John's economic profit is his total revenue, \$43,000, minus his total opportunity cost, \$88,500, for an economic loss of \$45,500.

18. Market shares of smartphone producers are in the table.

Calculate the Herfindahl-Hirschman Index. What is the structure of the smartphone industry?

The Herfindahl-Hirschman Index is 3,054. The Herfindahl-Hirschman Index equals the sum of the squares of the market shares of the 50 largest firms or of all firms if there are less than 50 firms. The Herfindahl-Hirschman Index equals $38^2 + 38^2 + 4^2 + 5^2 + 5^2 + 10^2$, which equals 3,054.

This industry is highly concentrated and dominated by a few firms as in an oligopoly because the Herfindahl-Hirschman Index is higher than 2,500.

Firm	Market share (percent)
Apple	38
Samsung	38
Sony	4
HTC	5
Lenovo	5
LG	10

Chapter 11

Use the table to work Problems 2 to 6.

The table sets out Sue's Surfboards' total product schedule.

2. Draw the total product curve.

To draw the total product curve measure labor on the x-axis and output on the y-axis. The total product curve is upward sloping and is illustrated in Figure 11.1.

3. Calculate the average product of labor and draw the average product curve.

The average product of labor is equal to total product divided by the quantity of labor employed. For example, when 3 workers are employed, they produce 120 surfboards a week, so average product is 40 surfboards per worker. As Figure 11.2 (on the next page) shows, the average product curve is upward sloping when up to 3 workers are hired and then is downward sloping when more than 4 workers are hired.

4. Calculate the marginal product of labor and draw the marginal product curve.

The marginal product of labor is equal to the increase in total product that results from a one-unit increase in the quantity of labor employed. For example, when 3 workers are employed, total product is 120 surfboards a week. When a fourth worker is employed, total product increases to 160 surfboards a week. The marginal product of increasing the number of workers from 3 to 4 is 40 surfboards. We plot the marginal product at the halfway point, so at a quantity of 3.5 workers, the marginal product is 40 surfboards per worker per week. As Figure 11.2 shows, the marginal product curve is upward sloping when up to 2.5 workers a week are employed and it is downward sloping when more than 2.5 workers a week are employed.

Labor (workers per week)	Output (surfboards per week)
1	30
2	70
3	120
4	160
5	190
6	210
7	220

FIGURE 11.1

Problem 2

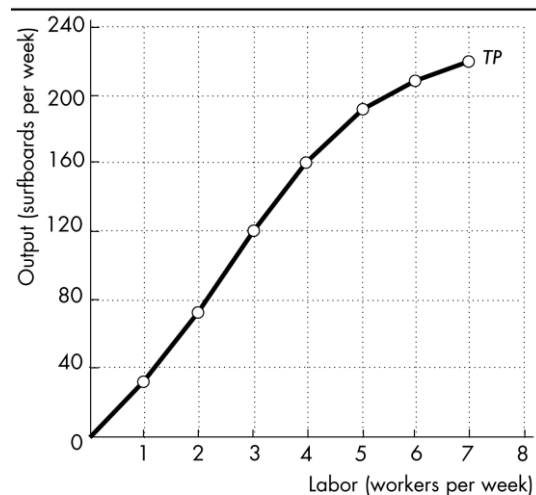
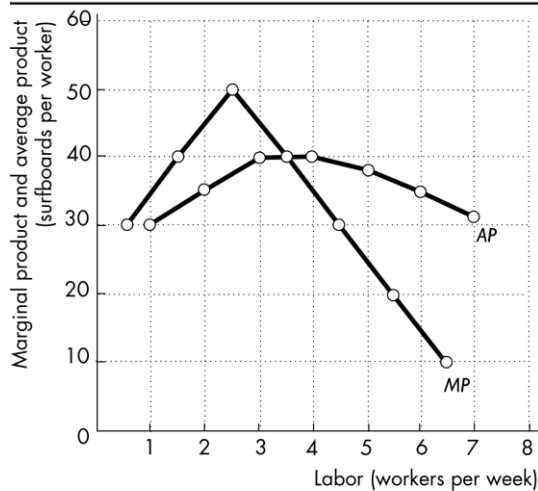


FIGURE 11.2
Problems 3 and 4



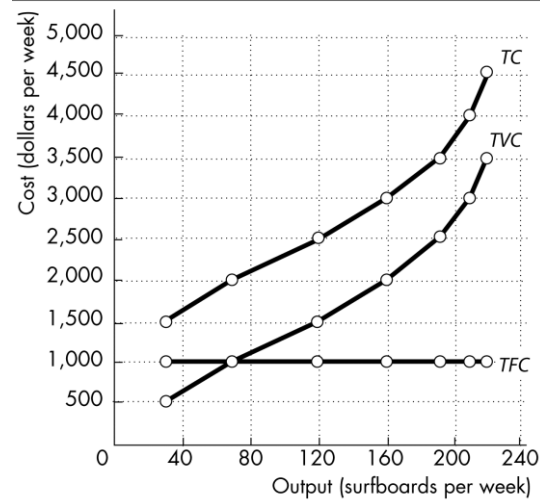
5. a. Over what output range does Sue's Surfboards enjoy the benefits of increased specialization and division of labor?
The firm enjoys the benefits of increased specialization and division of labor over the range of output for which the marginal cost decreases. This range of output is the same range over which the marginal product of labor rises. For Sue's Surfboards, the benefits of increased specialization and division of labor occur until 2.5 workers are employed.
- b. Over what output range does the firm experience diminishing marginal product of labor?
The marginal product of labor decreases after the 3rd worker is employed.
- c. Over what output range does the firm experience an increasing average product of labor but a diminishing marginal product of labor?
The marginal product of labor decreases and the average product of labor increases between 2.5 and 3.5 workers.
6. Explain how it is possible for a firm to experience simultaneously an increasing *average* product but a diminishing *marginal* product.
As long as the marginal product of labor exceeds the average product of labor, the average product of labor rises. For a range of output the marginal product of labor, while decreasing, remains greater than the average product of labor, so the average product of labor rises. Each additional worker, while producing less than the previous worker hired is still producing more than the average worker.

Use the following data to work Problems 7 to 11.
Sue's Surfboards, in Problem 2, hires workers at \$500 a week and its total fixed cost is \$1,000 a week.

7. Calculate total cost, total variable cost, and total fixed cost of each output in the table. Plot these points and sketch the short-run total cost curves passing through them.

Total cost is the sum of the costs of all the factors of production that Sue's Surfboards uses. Total variable cost is the total cost of the variable factors. Total fixed cost is the total cost of the fixed factors. For example, the total variable cost of producing 120 surfboards a week is the total cost of the workers employed, which is 3 workers at \$500 a week, which equals \$1,500. Total fixed cost is \$1,000, so the total cost of producing 120 surfboards a week is \$2,500. Figure 11.4 (on the previous page) shows these total cost curves.

FIGURE 11.3
Problem 7

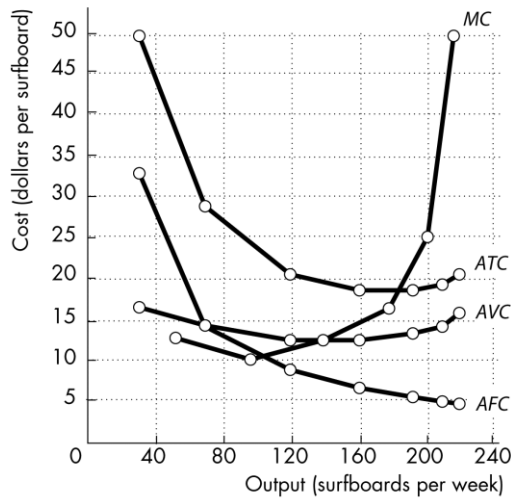


8. Calculate average total cost, average fixed cost, average variable cost, and marginal cost of each output in the table. Plot these points and sketch the short-run average and marginal cost curves passing through them.

Output (surfboards)	AFC (dollars per surfboard)	AVC (dollars per surfboard)	ATC (dollars per surfboard)	MC (dollars per surfboard)
30	33.33	16.67	50.00	
70	14.29	14.29	28.58	12.50
120	8.33	12.50	20.83	10.00
160	6.25	12.50	18.75	12.50
190	5.26	13.16	18.42	16.67
210	4.76	14.29	19.05	25.00
220	4.55	15.91	20.46	50.00

FIGURE 11.4

Problem 8



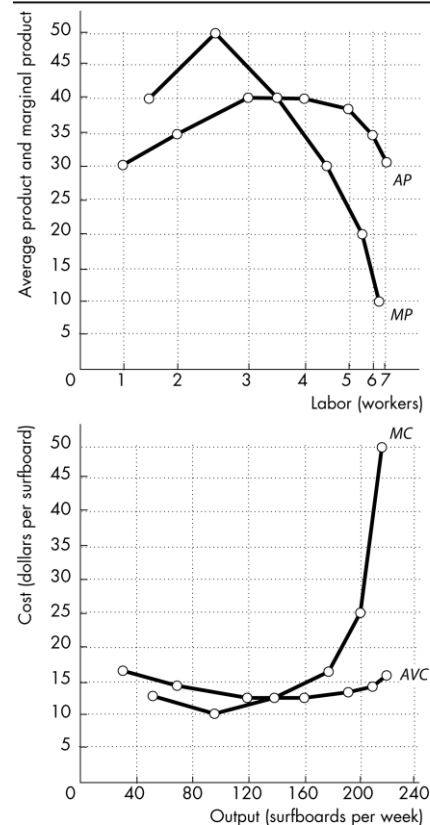
Average fixed cost is total fixed cost per unit of output. Average variable cost is total variable cost per unit of output. Average total cost is the total cost per unit of output. For example, take the case in which the firm makes 160 surfboards a week. Total fixed cost is \$1,000, so average fixed cost is \$6.25 per surfboard; total variable cost is \$2,000, so average variable cost is \$12.50 per surfboard; and, total cost is \$3,000, so average total cost is \$18.75 per surfboard. Marginal cost is the increase in total cost divided by the increase in output. For example, when output increases from 120 to 160 surfboards a week, total cost increases from \$2,500 to \$3,000, an increase of \$500. This \$500 increase in total cost means that the increase in output of 40 surfboards increases total cost by \$500. Marginal cost is equal to \$500 divided by 40 surfboards, which is \$12.50 a surfboard. The table shows these data schedules and the curves are plotted in Figure 11.4.

9. Illustrate the connection between Sue's AP, MP, AVC, and MC curves in graphs like those in Fig. 11.7.

Labor (workers)	Output (surfboards)	AP (surfboards per worker)	MP (surfboards per worker)	AVC (dollars per surfboard)	MC (dollars per surfboard)
1	30	30.0		16.67	
2	70	35.0	40.0	14.29	12.50
3	120	40.0	50.0	12.50	10.00
4	160	40.0	40.0	12.50	12.50
5	190	38.0	30.0	13.16	16.67
6	210	35.0	20.0	14.29	25.00
7	220	31.4	10.0	15.91	50.00

The table sets out the data used to draw the curves. Figure 11.5 shows the curves and the relationships. When the *AP* curve rises the *AVC* curve falls and vice versa. When the *MP* curve rises the *MC* curve falls and vice versa.

FIGURE 11.5
Problem 9



10. Sue's Surfboards rents a factory. If the rent rises by \$200 a week and other things remain the same, how do Sue's Surfboards' short-run average cost curves and marginal cost curve change?
- The rent is a fixed cost, so total fixed cost increases. The increase in total fixed cost increases total cost but does not change total variable cost. Average fixed cost is total fixed cost per unit of output. The average fixed cost curve shifts upward. Average total cost is total cost per unit of output. The average total cost curve shifts upward. The marginal cost curve and average variable cost curve do not change.
11. Workers at Sue's Surfboards negotiate a wage increase of \$100 a week per worker. If other things remain the same, explain how Sue's Surfboards' short-run average cost curves and marginal cost curve change.

The increase in the wage rate is a variable cost, so total variable cost increases. The increase in total variable cost increases total cost but total fixed cost does not change. Average variable cost is total variable cost per unit of output. The average variable cost curve shifts upward. Average total cost is total cost per unit of output. The average total cost curve shifts upward. The marginal cost curve shifts upward while the average fixed cost curve does not change.

Labor (workers per day)	Output (rides per day)			
	Plant 1	Plant 2	Plant 3	Plant 4
10	20	40	55	65
20	40	60	75	85
30	65	75	90	100
40	75	85	100	110
Canoes	10	20	30	40

Use the following data to work Problems 12 to 14.

Jackie's Canoe Rides rents canoes at \$100 per day and pays \$50 per day for each canoe operator it hires. The table shows the firm's production function.

12. Graph the ATC curves for Plant 1 and Plant 2. Explain why these ATC curves differ.

To find the average total cost for each plant, at the different levels of output add the cost of the workers, \$50 per worker, and the fixed cost, the cost of the canoes, \$100 per canoe. So for plant 1, the total cost for 20 rides is \$1,500; for 40 rides is \$2,000; and, for 65 rides is \$2,500. The average total cost is calculated by dividing the total cost by the quantity of rides. These average total costs are plotted in Figure 11.6. (The average total cost curve for one plant, ATC_1 , is the same as the thicker curve through the first 4 points.) The curves differ because the number of plants differs.

13. Graph the ATC curves for Plant 3 and Plant 4. Explain why these ATC curves differ.

These are drawn in Figure 11.6. The curves differ because the number of plants differs.

14. a. On Jackie's LRAC curve, what is the average cost of producing 40, 75, and 85 rides a week?

The long-run average total cost curve is illustrated in Figure 11.6 as the thicker curve. It is comprised of the parts of the short-run average total cost curves that are the minimum average total cost for the different levels of output. From this curve, the average cost of producing 40 rides is \$50; of producing 75 rides is \$40; and the average cost of producing 85 rides is \$47.06.

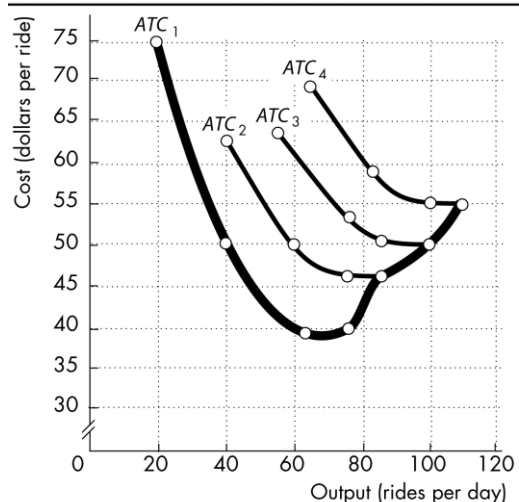
- b. What is Jackie's minimum efficient scale?

Jackie's minimum efficient scale is the smallest quantity at which the long-run average cost is the lowest. Jackie's minimum efficient scale is 65 canoe rides where, with one plant, the average total cost is \$38.46.

- c. Does Jackie's production function feature economies of scale or diseconomies of scale?

Jackie's has both economies of scale for up to 65 canoe rides and then diseconomies of scale for more than 65 canoe rides.

FIGURE 11.6
Problems 12 and 13



19. Bill's Bakery has a fire and Bill loses some of his cost data. The bits of paper that he recovers after the fire provide the information in the following table (all the cost numbers are dollars).

Bill asks you to come to his rescue and provide the missing data in the five spaces identified as A, B, C, D, and E.

A is the average fixed cost, AFC , when the output is 20. Average fixed cost equals total fixed cost divided by output, or $AFC = TFC \div Q$. Rearranging gives $TFC = AFC \times Q$. So the total fixed cost for the problem equals $\$120 \times 10$, which is \$1,200. A equals \$1,200, TFC , divided by 20, Q , which is \$60.

B is the average variable cost, AVC , when output is 20. Use the result that $AFC + AVC = ATC$ by rearranging to give $AVC = ATC - AFC$, so average variable cost equals $\$150 - \60 , which is \$90.

TP	AFC	AVC	ATC	MC
10	120	100	220	
				80
20	A	B	150	
				90
30	40	90	130	
				130
40	30	C	D	
				E
50	24	108	132	

D is the average total cost, ATC , when output, Q , equals 40. Average total cost equals total cost divided by output, or $ATC = TC \div Q$. Rearranging gives $TC = ATC \times Q$. So the total cost when 30 units are produced is $\$130 \times 30$, which is $\$3,900$. Marginal cost, MC , equals the change in total cost divided by the change in quantity, or $MC = \Delta TC \div \Delta Q$. Rearranging gives $\Delta TC = MC \times \Delta Q$, so the change in total cost between $Q = 30$ and $Q = 40$ is $\$130 \times 10$, or $\$1,300$. Therefore the total cost when Q equals 40 is $\$3,900 + \$1,300$, or $\$5,200$. The average total cost when Q is 40 is $\$5,200 \div 40$, or $\$130$.

C is the average variable cost, AVC , when output, Q , equals 40. Use the result that $AFC + AVC = ATC$ by rearranging to give $AVC = ATC - AFC$. As a result, average variable cost equals $\$130 - \30 , or $\$100$.

E is the marginal cost, MC , when output increases from 40 units to 50 units. Marginal cost, MC , equals the change in total cost divided by the change in quantity, or $MC = \Delta TC \div \Delta Q$. To calculate marginal cost, the total cost when output is 40 and the total cost when output is 50 are needed. Average total cost equals total cost divided by output, or $ATC = TC \div Q$. Rearranging gives $TC = ATC \times Q$. So the total cost when 40 units are produced is $\$130 \times 40$, which is $\$5,200$ and total cost when 50 units are produced is $\$132 \times 50$, which is $\$6,600$. So the marginal cost equals $(\$6,600 - \$5,200) \div 10$, which equals $\$140$.
