8

Market Structure: Perfect Competition and Monopoly

One of the most important decisions made by a manager is how to price the firm's product. If the firm is a profit maximizer, the price charged must be consistent with the realities of the market and economic environment within which the firm operates. Remember, price is determined through the interaction of supply and demand. A firm's ability to influence the selling price of its product stems from its ability to influence the market supply and, to a lesser extent, on its ability to influence consumer demand, as, say, through advertising.

One important element in the firm's ability to influence the economic environment within which it operates is the nature and degree of competition. A firm operating in an industry with many competitors may have little control over the selling price of its product because its ability to influence overall industry output is limited. In this case, the manager will attempt to maximize the firm's profit by minimizing the cost of production by employing the most efficient mix of productive resources. On the other hand, if the firm has the ability to significantly influence overall industry output, or if the firm faces a downward-sloping demand curve for its product, the manager will attempt to maximize profit by employing an efficient input mix and by selecting an optimal selling price.

Definition: Market structure refers to the environment within which buyers and sellers interact.

CHARACTERISTICS OF MARKET STRUCTURE

There are, perhaps, as many ways to classify a firm's competitive environment, or market structure, as there are industries. Consequently, no

single economic theory is capable of providing a simple system of rules for optimal output pricing. It is possible, however, to categorize markets in terms of certain basic characteristics that can be useful as benchmarks for a more detailed analysis of optimal pricing behavior. These characteristics of market structure include the number and size distribution of sellers, the number and size distribution of buyers, product differentiation, and the conditions of entry into and exit from the industry.

NUMBER AND SIZE DISTRIBUTION OF SELLERS

The ability of a firm to set its output price will largely depend on the number of firms in the same industry producing and selling that particular product. If there are a large number of equivalently sized firms, the ability of any single firm to independently set the selling price of its product will be severely limited. If the firm sets the price of its product higher than the rest of the industry, total sales volume probably will drop to zero. If, on the other hand, the manager of the firm sets the price too low, then while the firm will be able to sell all that it produces, it will not maximize profits. If, on the other hand, the firm is the only producer in the industry (monopoly) or one of a few large producers (oligopoly) satisfying the demand of the entire market, the manager's flexibility in pricing could be quite considerable.

NUMBER AND SIZE DISTRIBUTION OF BUYERS

Markets may also be categorized by the number and size distribution of buyers. When there are many small buyers of a particular good or service, each buyer will likely pay the same price. On the other hand, a buyer of a significant proportion of an industry's output will likely be in a position to extract price concessions from producers. Such situations refer to monopsonies (a single buyer) and oligopsonies (a few large buyers).

PRODUCT DIFFERENTIATION

Product differentiation is the degree that the output of one firm differs from that of other firms in the industry. When products are undifferentiated, consumers will decide which product to buy based primarily on price. In these markets, producers that price their product above the market price will be unable to sell their output. If there is no difference in price, consumers will not care which seller buy from. A given grade of wheat is an example of an undifferentiated good. At the other extreme, firms that produce goods having unique characteristics may be in a position to exert considerable control over the price of their product. In the automotive industry, for example, product differentiation is the rule.

CONDITIONS OF ENTRY AND EXIT

The ease with which firms are able to enter and exit a particular industry is also crucial in determining the nature of a market. When it is difficult for firms to enter into an industry, existing firms will have much greater influence in their output and pricing decisions than they would if they had to worry about increased competition from new comers, attracted to the industry by high profits. In other words, managers can make pricing decisions without worrying about losing market share to new entrants. Thus if a firm owns a patent for the production of a good, this effectively prohibits other firms from entering the market. Such patent protection is a common feature of the pharmaceutical industry.

Exit conditions from the industry also affect managerial decisions. Suppose that a firm had been earning below-normal economic profit on the production and sale of a particular product. If the resources used in the production of that product are easily transferred to the production of some other good or service, some of those resources will be shifted to another industry. If, however, resources are highly specialized, they may have little value in another industry.

In this and the next two chapters we will examine four basic market structures: perfect competition, monopoly, oligopoly, and monopolistic competition. For purposes of our analysis we will assume that the firms in each of these market structures are price takers in resource markets and that they are producing in the short run. The result of these assumptions is that the cost curves of each firm in these industries will have the same general shape as those presented in Chapter 6.

Firms differ in the proportion of total market demand that is satisfied by the production of each. This is illustrated in Figure 8.1. At one extreme is perfect competition, in which the typical firm produces only a very small percentage of total industry output. At the other extreme is monopoly, where the firm is responsible for producing the entire output of the industry. The percentage of total industry output produced is critical in the analysis of profit maximization because it defines the shape of the demand curve facing the output of each individual firm. The market structures that will be examined in this and the next chapter can be viewed as lying along a spectrum, with the position of each firm defined by the percentage of the market

FIGURE 8.1 Market structure is defined in terms of the proportion of total market demand that is satisfied by the output of each firm in the industry.

satisfied by the typical firm in each industry—from perfect competition at one extreme to monopoly at the other.

PERFECT COMPETITION

The expression "perfect competition" is somewhat misleading because overt competition among firms in perfectly competitive industries is nonexistent. The reason for this is that managers of perfectly competitive firms do not take into consideration the actions of other firms in the industry when setting pricing policy. The reason for this is that changes in the output of each firm are too small relative to the total output of the industry to significantly affect the selling price. Thus, the selling price is parametric to the decision-making process.

The characteristics of a perfectly competitive market may be identified by using the criteria previously enumerated. Perfectly competitive industries are characterized by a large number of more or less equally sized firms. Because the contribution of each firm to the total output of the industry is small, the output decisions of any individual firm are unlikely to result in a noticeable shift in the supply curve. Thus, the output decisions of any individual firm will not significantly affect the market price. Thus, firms in perfectly competitive markets may be described as *price takers*. The inability to influence the market price through output changes means that the firm lacks *market power*.

Definition: Market power refers to the ability of a firm to influence the market price of its product by altering its level of output. A firm that produces a significant proportion of total industry output is said to have market power.

Definition: A firm is described as a price maker if it has market power. A price maker faces a downward-sloping demand curve for its product, which implies that the firm is able to alter the market price of its product by changing its output level.

Definition: Perfect competition refers to the market structure in which there are many utility-maximizing buyers and profit-maximizing sellers of a homogeneous good or service in which there is perfect mobility of factors of production and buyers, sellers have perfect information about market conditions, and entry into and exit from the industry is very easy.

Definition: A perfectly competitive firm is called a price taker because of its inability to influence the market price of its product by altering its level of output. This condition implies that a perfectly competitive firm should be able to sell as much of its good or service at the prevailing market price.

A second requirement of a perfectly competitive market is that there also be a large number of buyers. Since no buyer purchases a significant

proportion of the total output of the industry, the actions of any single buyer will not result in a noticeable shift in the demand schedule and, therefore, will not significantly affect the equilibrium price of the product.

A third important characteristic of perfectly competitive markets is that the output of one firm cannot be distinguished from that of another firm in the same industry. The purchasing decisions of buyers, therefore, are based entirely on the selling price. In such a situation, individual firms are unable to raise their prices above the market-determined price for fear of being unable to attract buyers. Conversely, price cutting is counterproductive because firms can sell all their output at the higher, market-determined, price. Remember, the market clearing price of a product implies that there is neither a surplus nor a shortage of the commodity.

A final characteristic of perfectly competitive markets is that firms may easily enter or exit the industry. This characteristic allows firms to easily reallocate productive resources to be able to exploit the existence of economic profits. Similarly, if profits in a given industry are below normal, firms may easily shift productive resources out of the production of that particular good into the production of some other good for which profits are higher.

THE EQUILIBRIUM PRICE

As we have already discussed, the market-determined price of a good or service is accepted by the firm in a perfectly competitive industry as datum. Moreover, the equilibrium price and quantity of that good or service are determined through the interaction of supply and demand. The relation between the market-determined price and the output decision of a firm is illustrated in Figure 8.2.

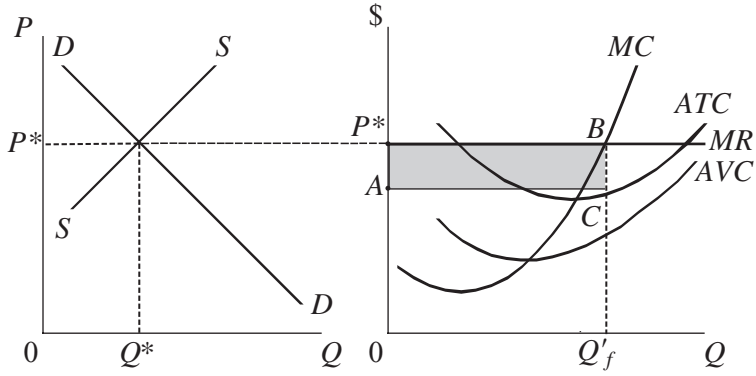

FIGURE 8.2 Short-run competitive equilibrium with positive (above-normal) economic profit.

The market demand for a good or service is the horizontal summation of the demands of individual consumers, while the market supply curve is the sum of individual firms' marginal cost (above-average variable cost) curves. As discussed earlier, if the prevailing price is above the equilibrium price (P^*), a condition of excess supply forces producers to lower the selling price to rid themselves of excess inventories. As the price falls, the quantity of the product demanded rises, while the quantity supplied from current production falls (Q_F). Alternatively, if the selling price is below P^* a situation of excess demand arises. This causes consumers to bid up the price of the product, thereby reducing the quantity available to meet consumer demands, while compelling producers to increase production. This adjustment dynamic will continue until both excess demand and excess supply have been eliminated at P^*.

Problem 8.1. Suppose that a perfectly competitive industry comprises 1,000 identical firms. Suppose, further, that the market demand (Q_D) and supply (Q_S) functions are

$$Q_D = 170,000,000 - 10,000,000P$$

$$Q_S = 70,000,000 + 15,000,000P$$

a. Calculate the equilibrium market price and quantity?
b. Given your answer to part a, how much output will be produced by each firm in the industry?
c. Suppose that one of the firms in the industry goes out of business. What will be the effect on the equilibrium market price and quantity?

Solution

a. Equating supply and demand yields

$$170,000,000 - 10,000,000P = 70,000,000 + 15,000,000P$$

$$P^* = \$4.00$$

Substituting the equilibrium price into either the market supply or demand equation yields

$$\begin{aligned} Q^* &= 170,000,000 - 10,000,000(4) \\ &= 70,000,000 + 15,000,000(4) = 130,000,000 \end{aligned}$$

b. Since there are 1,000 identical firms in the industry, the output of any individual firm Q_i is

$$Q_i = \frac{Q^*}{1,000} = \frac{130,000,000}{1,000} = 130,000$$

c. The supply equation of any individual firm in the industry is

$$Q_i = \frac{Q^*}{1,000} = 70,000 + 15,000P$$

Subtracting the supply of the individual firm from market supply yields

$$\begin{aligned} Q^* - Q_i &= (70,000,000 + 15,000,000P) - (70,000 + 15,000P) \\ &= 69,930,000 + 14,985,000P \end{aligned}$$

Equating the new market demand and supply equations yields

$$170,000,000 - 10,000,000P = 69,930,000 + 14,985,000P$$

$$P^* = \$4.0052$$

$$\begin{aligned} Q^* &= 170,000,000 - 10,000,000(4.0052) \\ &= 69,930,000 + 14,985,000(4.0052) = 129,948,000 \end{aligned}$$

This problem illustrates the virtual inability of an individual firm in a perfectly competitive industry, which is characterized by a large number of firms, to significantly influence the market equilibrium price of a good or service by changing its level of output. For this reason, it is generally assumed that the market price for a perfectly competitive firm is parametric.

SHORT-RUN PROFIT MAXIMIZATION PRICE AND OUTPUT

If we assume that the perfectly competitive firm is a profit maximizer, the pricing conditions under which this objective is achieved are straightforward. First, define the firm's profit function as:

$$\pi(Q) = TR(Q) - TC(Q) \tag{8.1}$$

To determine the optimal output level that is consistent with the profit-maximizing objective of this firm, the first-order condition dictates that we differentiate this expression with respect to Q and equate the resulting expression to zero. This procedure yields the following results

$$\frac{d\pi(Q)}{dQ} = \frac{dTR(Q)}{dQ} - \frac{dTC(Q)}{dQ} = 0 \tag{8.2}$$

or

$$MR - MC = 0 \tag{8.3}$$

That is, the profit-maximizing condition for this firm is to equate marginal revenue with marginal cost, $MR = MC$.

To carry this analysis a bit further, recall that the definition of total revenue is $TR = PQ$. The preceding analysis of a perfectly competitive market reminds us that the selling price is determined in the market and is unaffected by the output decisions of any individual firm. Therefore,

$$\frac{dTR(Q)}{dQ} = MR = P_0 \tag{8.4}$$

where the selling price is determined in the market and parametric to the firm's output decisions. Thus, the profit-maximizing condition for the perfectly competitive firm becomes

$$P_0 = MC \tag{8.5}$$

To maximize its short-run (and long-run) profits, the perfectly competitive firm must equate the market-determined selling price of its product with the marginal cost of producing that product. This condition was illustrated in Figure 8.2 (right).

Assuming that the firm has U-shaped average total and marginal cost curves, Figure 8.2 illustrates that the perfectly competitive firm maximizes profits by producing $0Q_f$ units of output, that is, the output level at which $P^* = MC$. The economic profit earned is illustrated by the shaded area AP*BC in the figure. This can be seen when we remember that

$$\pi = TR - TC = P^* Q_f - ATC(Q_f) \tag{8.6}$$

This is illustrated in Figure 8.2 as

$$\text{Area}\{AP^*BC\} = \text{Area}\{0P^*BQ_f\} - \text{Area}\{0ACQ_f\} \tag{8.7}$$

It should be remembered that the cost curves of Figure 8.2 include a normal rate of profit. As a consequence, any time the firm has an average revenue greater than average cost, it is earning an economic profit.

Definition: A firm earns economic (above-normal) profit when total revenue is greater than total economic cost.

Problem: 8.2. Consider the firm with the following total monthly cost function, which includes a normal profit.

$$TC = 1{,}000 + 2Q + 0.01Q^2$$

The firm operates in a perfectly competitive industry and sells its product at the market-determined price of $10. To maximize total profits, what should be the firm's monthly output level, and how much economic profit will the firm earn each month?

Solution. First, determine the firm's marginal cost function by taking the first derivative of the total cost function with respect to Q.

$$\frac{dTC}{dQ} = MC = 2 + 0.02Q$$

As discussed earlier, profit is maximized by setting $MC = P^*$, thus

$$10 = 2 + 0.02Q$$

$$Q = 400$$

Economic profit is given by the expression

$$\pi = TR - TC = P*Q - 1{,}000 - 2Q - 0.01Q^2$$
$$= \$10(400) - 1{,}000 - 2(400) - 0.01(4002) = \$600$$

Problem 8.3. A perfectly competitive industry consists of 300 firms with identical cost structures. The respective market demand (Q_D) and market supply (Q_S) equations for the good produced by this industry are

$$Q_D = 3{,}000 - 60P$$

$$Q_s = 500 + 40P$$

a. What are the profit-maximizing price and output for each individual firm?
b. Assume that each firm is in long-run competitive equilibrium. Determine each firm's total revenue, total economic cost, and total economic profit.

Solution

a. Firms in a perfectly competitive industry are characterized as "price takers." The profit-maximizing condition for firms in a perfectly competitive industry is $P = MC$, where the price is determined in the market. The market equilibrium price and quantity are determined by the condition

$$Q_D = Q_S$$

$$3{,}000 - 60P = 500 + 40P$$

$$P^* = \$25$$

$$Q^* = 500 + 40(25) = 500 + 1{,}000 = 1{,}500$$

The market equilibrium price, which is the price for each individual firm, is $P^* = \$25$. The market equilibrium output is $Q = 1{,}500$. Since there are 300 firms in the industry, each firm supplies $Q_i = 1{,}500/300 = 5$ units.

b. The total revenue of each firm in the industry is

$$TR = P*Q_i = 25(5) = \$125$$

In long-run competitive equilibrium, each firm earns zero economic profit. Since economic profit is defined as the difference between total revenue and total economic cost, then the total economic cost of each firm is

$$TC_{\text{economic}} = \$125$$

Problem 8.4. The market-determined price in a perfectly competitive industry is $P = \$10$. Suppose that the total cost equation of an individual firm in the industry is given by the expression

$$TC = 100 + 5Q + 0.02Q^2$$

a. What is the firm's profit-maximizing output level?
b. Given your answer to part a, what is the firm's total profit?
c. Diagram your answers to parts a and b.

Solution

a. The profit-maximizing condition for a firm in a perfectly competitive industry is

$$P_0 = MC$$

The firm's marginal cost equation is

$$MC = \frac{dTC}{dQ} = 5 + 0.04Q$$

Substituting these results into the profit-maximizing condition yields

$$10 = 5 + 0.04Q$$

$$0.04Q = 5$$

$$Q^* = 125$$

b. The perfectly competitive firm's profit at $P^* = \$10$ and $Q^* = 125$ is

$$\begin{aligned}\pi^* &= TR - TC \\ &= P^*Q^* - (100 + 5Q^* + 0.02Q^{*2}) \\ &= 10(125) - \left[100 + 5(125) + 0.02(125)^2\right] \\ &= 1{,}250 - 1{,}037.50 = \$212.50\end{aligned}$$

c. Figure 8.3 diagrams the answers to parts a and b.

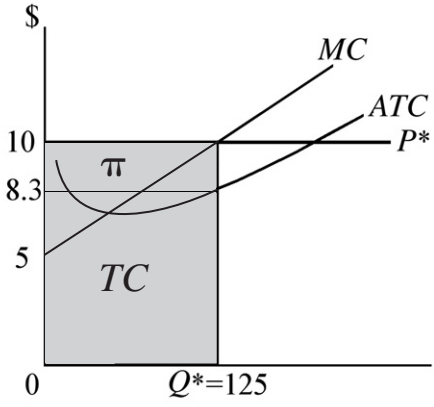

FIGURE 8.3 Diagrammatic solution to problem 8.4.

LONG-RUN PROFIT MAXIMIZATION PRICE AND OUTPUT

The shaded area in Figure 8.2 represents the firm's total economic profit, that is, the excess of total revenue over total cost of production after a normal rate of return (normal profit) has been taken into consideration. In a perfectly competitive industry, however, this situation will not long persist.

We have already mentioned that a key characteristic of a perfectly competitive industry is ease of entry and exit by potentially competing firms. The existence of economic profits in an industry will attract productive resources into the production of that particular good or service. This transfer of resources will not, however, be instantaneous. It takes time for new firms to build production facilities and for existing firms to increase output. Nevertheless, in the long run all inputs are variable, and the increased output by new and existing firms will result in a right-shift of the market supply curve. Consider Figure 8.4.

In Figure 8.4, a right-shift of the industry supply function has resulted in a fall of the equilibrium price from P^* to P' and an increase in the equilibrium output from Q^* to Q'. But note what has happened to the typical firm in this perfectly competitive industry. The decline in the market equilibrium price has reduced the economic profit to the firm to the shaded area $A'P'B'C'$. In fact, because of the upward sloping marginal cost function, not only has the selling price of the firm's product fallen but the output of the typical firm has dropped as well.

It should, of course, be noted that this result holds only for the "typical" firm. In fact, there is no *a priori* reason to suppose that all firms in a perfectly competitive industry are of equal size. Some existing firms after all

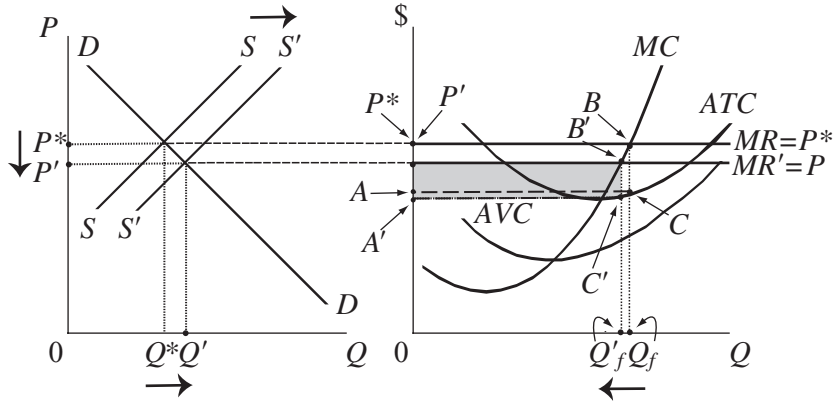

FIGURE 8.4 A price decline, short-run competitive equilibrium, and a reduction in economic (above-normal) profit.

will have increased their output by expanding operations in response to the existence of economic profits. The firm depicted in Figures 8.2 and 8.4 is not such a firm. If we assume that all firms in this industry are approximately the same size, then the output of each firm will decline, although industry output will increase because there are a larger number of firms.

The situation depicted in Figure 8.4 is not, however, stable in the long run, since the area $A'P'B'C'$ still represents a situation in which the firm is earning economic profits. The continued existence of economic profits will continue to attract resources to the production of the particular good or service in question. The situation of long-run competitive equilibrium is illustrated in Figure 8.5.

Figure 8.5 represents a break-even situation for the firm. Since normal profit is included in total cost, at the point where $MR'' = P'' = P = MC$, total revenues equal total costs. In Figure 8.5, P and Q represent the break-even price and output level for the individual firm, respectively. In this situation, the firm described in Figure 8.4 is no longer earning an economic profit, and thus there is no further incentive for firms outside the industry to transfer productive resources into this industry to earn above-normal profits. In a sense, economic profits have been "competed" away. Since there is no further incentive for firms to enter, or for that matter exit, this industry, it may be said that the firm is in a position of long-run competitive equilibrium.

Definition: The break-even price is the price at which total revenue is equal to total economic cost.

Definition: Economic cost is the sum of the firm's total explicit and implicit costs.

Unfortunately, the process of adjustment to long-run competitive equilibrium may not be as smooth as described in connection with Figure 8.5. If uncertainty and incomplete information lead managers to miscalculate,

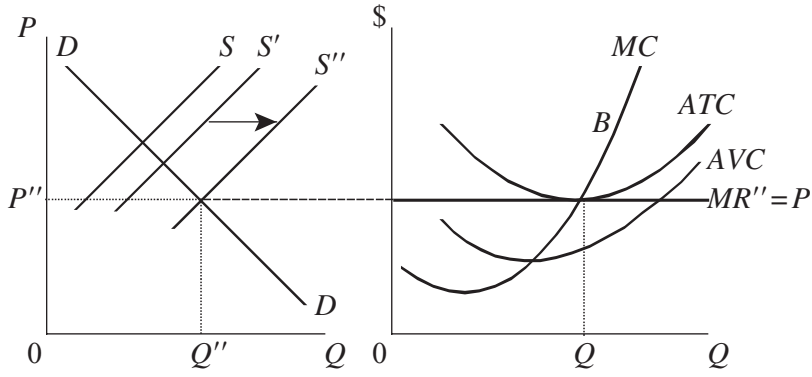

FIGURE 8.5 Long-run competitive equilibrium: zero economic (normal) profit.

too many firms will enter the industry. This situation is depicted in Figure 8.6: this firm is earning an economic loss (below-normal profit), illustrated by the area $P^{\dagger}A^{\dagger}B^{\dagger}C^{\dagger}$. This can be seen when we remember that

$$\pi = TR - TC = P^{\dagger}Q_f^{\dagger} - ATC \times Q_f^{\dagger} \tag{8.8}$$

This is illustrated in Figure 8.6 as

$$\text{Area}\{P^{\dagger}A^{\dagger}B^{\dagger}C^{\dagger}\} = \text{Area}\{0A^{\dagger}B^{\dagger}Q_f^{\dagger}\} - \text{Area}\{0P^{\dagger}C^{\dagger}Q_f^{\dagger}\} < 0 \tag{8.9}$$

In this situation, firms in this industry are earning below-normal profits. Under such circumstances, productive resources are transferred out of the production of this particular good or service, and output declines, resulting in a left-shift in the market supply function. Eventually, the selling price will rise and long-term competitive equilibrium will be reestablished.

Definition: A firm earns an economic loss when total revenue is less than total economic cost.

ECONOMIC LOSSES AND SHUTDOWN

For firms earning economic profits, the only meaningful decision facing management is the appropriate level of output. When firms are posting economic losses, however, the manager must decide whether it is in the long-run interests of the shareholders to continue producing that particular product. The course of action to be adopted by the manager will be based on a number of alternatives. The manager may decide, for example, to continue producing at the least unprofitable rate of output in the hope that prices will rebound, or the manager might decide to shut down operations completely. In the short run, the consequences of shutting down are illustrated in Figure 8.7.

Recall from Chapter 6 that total cost is the sum of total variable and total fixed cost, that is,

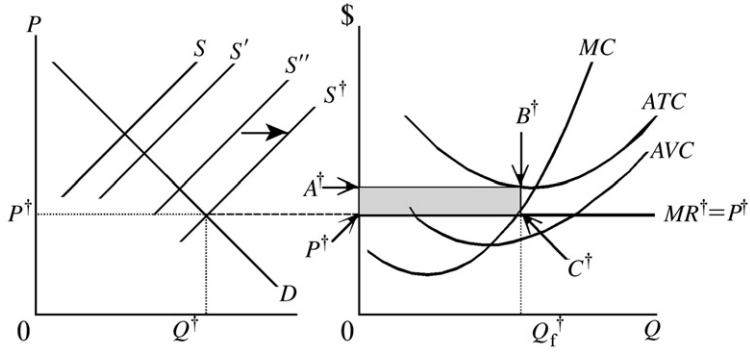

FIGURE 8.6 Short-run competitive equilibrium: economic loss (below-normal profit).

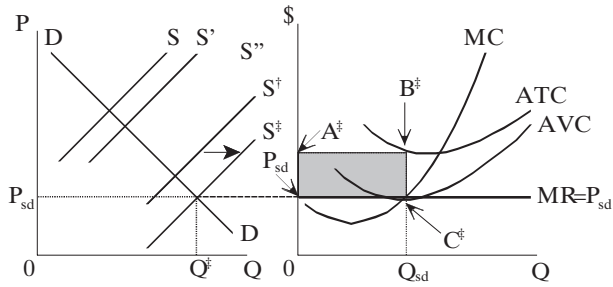

FIGURE 8.7 Shutdown price and output level.

$$TC = TFC + TVC$$

Definition: Total fixed cost refers to the firm's expenditures on fixed factors of production.

Definition: Total variable cost refers to the firm's expenditures on variable factors of production.

Dividing total cost by the level of output, we get

$$ATC = AFC + AVC$$

or

$$AFC = ATC - AVC$$

Diagrammatically, average fixed cost is measured by the vertical distance between the average total cost and average variable cost curves. It follows, therefore, that if the firm in Figure 8.6 produces at $Q^{\dagger}_{f}$ it will recover all of its variable costs and at least some of its fixed costs.

The essential element in the manager's decision is the discrepancy between the selling price of the product and average variable cost. As long as price is greater than average variable cost, the firm minimizes its loss by continuing to produce. Otherwise, the firm will suffer larger short-run losses, since it is still responsible for its fixed costs. On the other hand, when the price falls below average fixed cost, it will be in the firm's best interest to shut down operations, since to continue to produce would result in losses greater than its fixed cost obligations. This concept is illustrated in Figure 8.7.

In Figure 8.7, P_{sd} and Q_{sd} represent the firm's shutdown price and output level, respectively. A profit-maximizing firm that produces at all will produce Q_{sd}, where $MR = P_{sd} = MC$. In fact, the firm is indifferent to producing Q_{sd}, since the firm's economic loss, which is given by the area of the rectangle $P_{sd}A^{\ddagger}B^{\ddagger}C^{\ddagger}$ is equivalent to the firm's total fixed costs (i.e., the firm's economic loss if it shuts down). Below the price P_{sd}, however, the optimal decision by the firm's manager is to cease production, since the firm's total economic loss is greater than its total fixed cost.

Diagrammatically, it is often argued that the portion of the marginal cost curve that lies the average variable cost curve represents the firm's supply curve. The reason for this is that a profit-maximizing firm will produce at an output level at which $P = MC$. Since the marginal cost curve is upward sloping, then an increase in price essentially traces out the firm's supply curve.[1]

In Chapter 3 it was asserted that the market supply curve is the horizontal summation of the individual firms' supply curves. This assertion, however, is correct only as long as input prices remain unchanged. It is entirely possible that a simultaneous increase in the demand for inputs resulting from an increase in industry output will cause input prices to rise. When this occurs, the industry supply curve will be less price elastic than if input prices remained constant.

Definition: Shutdown price is equal to the minimum average variable cost of producing a good or service. Below this price the firm will shut down because the firm's loss, which will equal the total fixed cost, will be less than if the firm continues to stay in business.

We have mentioned that the optimal rule for the manager of the firm in the short run is to shut down when the selling price of the product falls below P_{sd}. This decision rule is subject to two qualifications. First, the firm will not shut down every time $P < AVC$. In many cases, the firm will incur substantial costs when a production process is shut down or restarted, as in the case of a blast furnace for manufacturing steel, which may require several days to bring up to operating temperature. Similarly, a firm that shuts down and then reopens may find that its customers are buying from other suppliers. The decision to shut down operations, therefore, is made only if in the opinion of the manager the price will stay below average variable cost for an extended period of time.

The second qualification involves the distinction between the short run and the long run. The decision to shut down depends on whether the firm can make a contribution to its fixed cost by continuing to produce. In the long run, however, there are no fixed costs. Buildings are sold, equipment is auctioned off, contracts expire, and so on. Thus, in the long run, as long as price is expected to remain below average variable cost, the firm will shut down. This decision rule applies in both the short and the long run.

Problem 8.5. A perfectly-competitive firm faces the following total variable cost function

[1] Strictly speaking, the assertion that the portion of the marginal cost curve that lies above the minimum average variable cost is the firm's supply curve is incorrect. The supply function is $Q_S = Q(P)$, where $dQ_S/dP > 0$; that is, output is a function of price. By contrast, the firm's total cost function is $TC = TC(Q)$, where $MC = MC(Q) = dTC/dQ > 0$; that is, marginal cost function is a function of output. Thus, the supply curve is really the inverse of the MC function. A formal derivation of the firm's supply curve is presented in Appendix 8A.

$$TVC = 150Q - 20Q^2 + Q^3$$

where Q is quantity. Below what price should the firm shut down its operations?

Solution. Find the output level that corresponds to the minimum average variable cost. First, calculate average variable cost

$$AVC = \frac{TVC}{Q} = 150 - 20Q + Q^2$$

Next, take the first derivative, equate the result to zero, and solve.

$$\frac{dAVC}{dQ} = -20 + 2Q = 0$$

$$Q = 10$$

Since the firm operates at the point where $P = MC$, substitute this result into the marginal cost function to yield

$$P = MC = \frac{dTVC}{dQ} = 150 - 40Q + 3Q^2 = 150 - 40(10) + 3(102) = \$50$$

Thus, if the price falls below \$50 per unit, then the firm should shut down.

Problem 8.6. Hale and Hearty Limited (HH) is a small distributor of B&Q Foodstores, Inc., in the highly competitive health care products industry. The market-determined price of a 100-tablet vial of HH's most successful product, papaya extract, is \$10. HH's total cost (TC) function is given as

$$TC = 100 + 2Q + 0.01Q^2$$

a. What is the firm's profit-maximizing level of output? What is the firm's profit at the profit-maximizing output level? Is HH in short-run or long-run competitive equilibrium? Explain.
b. At P = \$10, what is HH's break-even output level?
c. What is HH's long-run break-even price and output level?
d. What is HH's shutdown price and output level? Does this price–output combination constitute a short-run or a long-run competitive equilibrium? Explain.

Solution

a. Total profit is defined as the difference between total revenue (TR) and total cost, that is,

$$\pi = TR - TC = PQ - TC = 10Q - (100 + 2Q + 0.01Q^2)$$
$$= -100 + 8Q - 0.01Q^2$$

Differentiating this expression with respect to Q and setting the result equal to zero (the first-order condition for a local maximization) yields

$$\frac{d\pi}{dQ} = 8 - 0.02Q = 0$$

$$Q^* = 400$$

To verify that this output constitutes a maximum, differentiate the marginal profit function (take the second derivative of the total profit function). A negative value for the resulting expression constitutes a second-order condition for a local maximum.

$$\frac{d^2\pi}{dQ^2} = -0.02 < 0$$

Total profit at the profit-maximizing output level is

$$\pi^* = -100 + 8(400) - 0.01(400)^2 = -100 + 3,200 - 1,600 = \$1,500$$

HH is in short-run competitive equilibrium. In perfectly competitive markets, individual firms earn no economic profit in the long run. HH, however, is earning an economic profit of $1,500, which will attract new firms into the industry, which will increase supply and drive down the selling price of papaya extract (assuming that the demand for the product remains unchanged).

b. The break-even condition is defined as

$$TR = TC$$

Substituting into this definition gives

$$10Q = 100 + 2Q + 0.01Q^2$$

$$100 - 8Q + 0.01Q^2 = 0$$

This equation, which has two solution values, is of the general form

$$aQ^2 + bQ + c = 0$$

The solution values may be determined by factoring this equation, or by applying the quadratic formula, which is given as

$$Q_{1,2} = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

$$= \frac{-(-8) \pm \sqrt{\left[(-8)^2 - 4(0.01)(100)\right]}}{2(0.01)}$$

$$= \frac{8 \pm \sqrt{(64 - 4)}}{0.02} = \frac{8 \pm 7.746}{0.02}$$

$$Q_1 = \frac{8 + 7.746}{0.02} = 787.3$$

$$Q_2 = \frac{8 - 7.746}{0.02} = 12.7$$

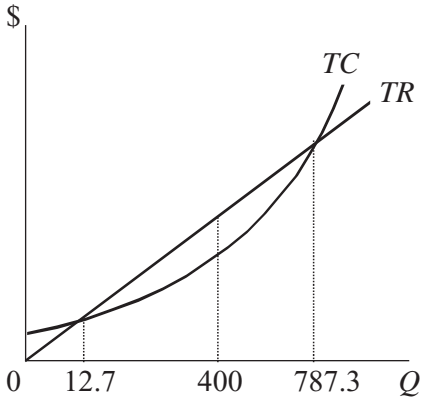

FIGURE 8.8 Diagrammatic solution to problem 8.6, part b.

These results indicate that there are two break-even output levels at $P = \$10$. Consider Figure 8.8.

c. In long-run competitive equilibrium, no firm in the industry earns an economic profit. It is an equilibrium in that while each firm earns a "normal" profit, there is no incentive for new firms to enter the industry, nor is there an incentive for existing firms to leave. The break-even price is defined in terms of the output level of which price is equal to minimum average total cost (ATC), that is,

$$P_{be} = ATC_{min}$$

ATC is given by the expression

$$ATC = \frac{TC}{Q} = \frac{100 + 2Q + 0.01Q^2}{Q} = 100Q^{-1} + 2 + 0.01Q$$

Minimizing this expression yields

$$\frac{dATC}{dQ} = -100Q^{-2} + 0.01 = 0$$

which is a first-order condition for a local minimum.

$$0.01Q^2 = 100$$

$$Q^2 = 10{,}000$$

$$Q_{be} = 100$$

$$\frac{d^2ATC}{dQ^2} = 200Q^{-3} = \frac{200}{(100)^3} > 0$$

which is a second-order condition for a local minimum.
Substituting this result into the preceding condition yields

$$P_{be} = ATC_{min} = 100Q^{-1} + 2 + 0.01Q = \frac{100}{100} + 2 + 0.01(100) = 4$$

d. The firm's shutdown price is defined in terms of the output level of which price is equal to minimum average variable cost (*AVC*), that is,

$$P_{sd} = AVC_{min}$$

AVC is given by the expression

$$AVC = \frac{TVC}{Q} = \frac{2Q + 0.01Q^2}{Q} = 2 + 0.01Q$$

Since this expression is linear, *AVC* is minimized where $Q_{sd} = 0$. Substituting this result into the preceding condition we get

$$P_{sd} = AVC_{min} = 2 + 0.01Q = 2 + 0.01(0) = \$2$$

This result is a short-run competitive equilibrium. At a price below \$2, the firm's loss will exceed its fixed costs. Under these circumstances, it will pay the firm to go out of business, in which case its short-run loss will be limited to its fixed costs. Because the firm is earning an economic loss for $P < ATC$, there will be an incentive for firms to exit the industry, which will reduce supply. If the demand for papaya extract is constant, the result will be an increase in price. Firms will continue to exit the industry until economic losses have been eliminated, as illustrated in Figure 8.9.

MONOPOLY

We now turn out attention to the other market extreme, monopoly. Monopolies may be described in terms of the same characteristics used to discuss perfect competition.

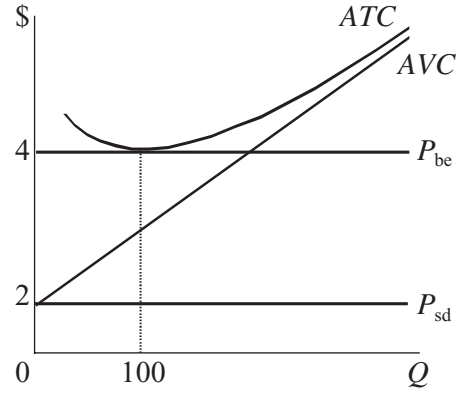

FIGURE 8.9 Diagrammatic solution to problem 8.6, part d.

In the case of a monopoly, the industry is dominated by a single producer. The most obvious implication of this is that the demand curve faced by the monopolist is the same downward-sloping market demand curve. Unlike the perfectly competitive firm, which produces too small a proportion of total industry output to significantly affect the market price, the output of the monopolist, is total industry output. Thus, for the monopolist, market prices are no longer parametric. An increase or decrease in the output will lower or raise the market price of the monopolist's product. For this reason, monopolists may be characterized as price makers.

Definition: The term "monopoly" is used to describe the market structure in which there is only one producer of a good or service for which there are no close substitutes and entry into and exit from the industry is impossible.

In the case of a monopoly, the number and size distribution of buyers is largely irrelevant, since the buyers of the firm's output have no bargaining power with which to influence prices. Such bargaining power is usually manifested through the explicit or implicit threat to obtain the desired product from a competing firm, which is nonexistent in a market sewed by a monopoly.

Goods and services produced by monopolies are unique. That is, the output of a monopolist has no close substitutes. In one respect, monopolies are diametrically opposed to perfectly competitive firm in that they do not have to compete with other firms in the industry. The output level of individual firms in perfectly competitive industries is so small relative to total industry output that each firm may effectively ignore the output decisions of other firms. A monopolist, on the other hand, is the only seller in an industry and, therefore, has no competitors.

For the firm to continue as a monopolist in the long run, there must exist barriers that prevent the entry of other firms into the industry. Such restrictions may be the result of the monopolist's control over scarce productive resources, patent rights, access to unique managerial talent, economies of scale, location, and so on. Another significant barrier to entry is found when a firm has a government franchise to be the sole provider of a good or service.

CONTROLLING SCARCE PRODUCTIVE RESOURCES

Until the 1940s, the Aluminum Company of America owned or controlled nearly 100% of the world's bauxite deposits. Since bauxite is needed to manufacture aluminum, that company, now known as Alcoa, was the sole producer and distributor of aluminum. Clearly, a firm that controls the entire supply of a vital factor of production will control production for the entire industry.

PATENT RIGHTS

A legal barrier to the entry of new firms into an industry is the *patent*. A patent, which is granted by a national government, is the exclusive right to a product or process by its inventor.[2] In the United States, patent protection is granted by Congress for a period of 20 years. Of course, during that period, the owner of the patent has the sole authority to produce for sale in the market the commodity protected by the patent.

Definition: A patent is the exclusive right granted to an inventor by government to a product or a process.

The rationale behind the granting of patents is that they provide an incentive for product research, development, invention, and innovation. Without such protection, investors are less likely to incur the often substantial development costs and risks associated with bringing a new product to market. On the other hand, the existence of patents discourages competition, which promotes product innovation, the development of more efficient, less costly production techniques, and lower prices. It is for these reasons that patents are not granted in perpetuity.

Arguments for and against patents have recently taken center stage in the United States in the debate over the escalating cost of health care. A frequently cited culprit has been the high price of prescription drugs. Pharmaceutical companies have been granted thousands of patents for a wide range of new prescription medicines, for which they have been able to charge monopoly prices. While recognizing that the high price of prescription medicines places a financial burden on some consumers, particularly the elderly, these companies nonetheless argue that the high prices are necessary as compensation for the millions of dollars in research and development costs. The companies also argue that these profits are necessary as compensation for the risks incurred in developing new products that are never brought to market or do not receive approval by the U.S. Food and Drug Administration.

GOVERNMENT FRANCHISE

Perhaps the most common example of a monopoly in the United States is the *government franchise*. Many firms are monopolies because the government has granted them the sole authority to supply a particular product within a given region. Public utilities are the most recognizable of government franchises. Government-franchised monopolies are usually justified on the grounds that it is more efficient for a single firm to produce, say,

[2] In the United States, patents are granted under Article I, Section 8, of the Constitution, which gives Congress the authority to "promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

electricity because of the large economies of scale involved and the desire to eliminate competing power grids. In exchange for this franchise, public utilities have agreed to be regulated. In principle, public utility commissions regulate the rates charged to ensure that the firm does not abuse its monopoly power.

Definition: A government franchise is a publicly authorized monopoly.

Fairness is another reason frequently cited in defense of government regulation. In many states, local telephone service is subject to regulation to ensure that consumers have access to affordable service. In fact, the profits earned by telephone companies from business users subsidize private household use, which is billed to individual consumers at below cost.

LAWSUITS

Monopolists can attempt to protect exclusive market positions by filing lawsuits against potential competitors claiming patent or copyright infringement. Start-up companies typically need to get their products to market as quickly as possible to generate cash flow. Regardless of the merits of lawsuits that may be brought against them, such cash-poor companies are financially unprepared to weather these legal challenges. In the end, the companies may be forced out of business, or may even be acquired by the monopolist.

SHORT-RUN PROFIT-MAXIMIZING PRICE AND OUTPUT

The case of the monopolist is illustrated in Figure 8.10. In the diagram we note that the monopolist faces the downward-sloping market demand curve, and the usual U-shaped marginal and average total cost curves. As

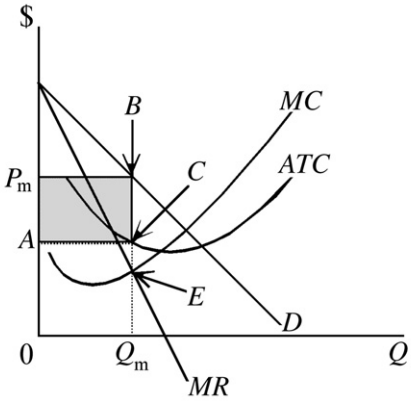

FIGURE 8.10 Monopoly: short-run and long-run profit-maximizing price and output.

in the case of a perfectly competitive firm, the profit-maximizing monopolist will adjust its output level up to the point at which the marginal cost of producing an addition unit of the good is just equal to the marginal revenue from its sale. This condition is satisfied at point E in Figure 8.7, at output level Q_m.

The selling price of the monopolist output is determined along the market demand function at P_m. At this price–quantity combination, the economic profit earned by the firm is illustrated by the shaded area AP_mBC.

If entry into this industry were relatively easy, the existence of such economic profits would attract scarce productive resources into the production of the monopolist's product. As new firms entered the industry, the demand function facing the monopolist at any given price would become more elastic (flatter), with economic profit being dissipated as a result of increase competition. Eventually, the industry might even approach the perfectly competitive market structure.

If, on the other hand, the monopolist's position in the industry is secure, economic profits could persist indefinitely. Thus, Figure 8.10 may depict both short-run and long-run profit-maximizing price and output.

Problem 8.7. Suppose that the total cost (TC) and demand equations for a monopolist is given by the following expressions:

$$TC = 500 + 20Q^2$$

$$P = 400 - 20Q$$

What are the profit-maximizing price and quantity?

Solution. The total revenue function for the firm is

$$TR = PQ = 400Q - 20Q^2$$

Define total profit as

$$\pi = TR - TC = 400Q - 20Q^2 - 500 - 20Q^2$$

Taking the first derivative, and setting the resulting expression equal to zero, yields the profit-maximizing output level.

$$\frac{d\pi}{dQ} = 400 - 80Q = 0$$

$$Q^* = 5$$

Substituting this result into the demand equation yields the selling price of the product

$$P^* = 400 - 20(5) = \$300$$

LONG-RUN PROFIT-MAXIMIZING PRICE AND OUTPUT

The long-run profit-maximizing price and output for a monopolist in the long run are the same as the short-run profit-maximizing price and output. The reason for this is that in the absence of changes in demand, profits to the monopolist will continue because restrictions to entry into the industry guarantee that these profits will not be competed away.

Problem 8.8. Suppose that an industry is dominated by a single producer and that the demand for its product is

$$Q_D = 3{,}000 - 60P$$

Suppose further that the total cost function of the firm is

$$TC = 100 + 5Q + \frac{1}{480}Q^2$$

a. What is the monopolist's profit-maximizing price and output?
b. Given your answer to part a, what is the firm's economic profit?

Solution

a. The profit-maximizing condition for a monopolist is

$$MR = MC$$

The monopolist's total revenue equation is

$$TR = PQ$$

Solving the demand equation for P yields

$$P = 50 - \frac{1}{60}Q$$

Substituting this result into the total revenue equation yields

$$TR = \left[50 - \left(\frac{1}{60}\right)Q\right]Q = 50Q - \left(\frac{1}{60}\right)Q^2$$

The monopolist's marginal revenue equation is

$$MR = \frac{dTR}{dQ} = 50 - \left(\frac{1}{30}\right)Q$$

The monopolist's marginal cost equation is

$$MC = \frac{dTC}{dQ} = 5 + \left(\frac{1}{240}\right)Q$$

Substituting these results into the profit-maximizing condition yields the profit-maximizing output level

$$50 - \left(\frac{1}{30}\right)Q = 5 + \left(\frac{1}{240}\right)Q$$

$$Q^* = 1,200$$

To determine the profit-maximizing price, substitute this result into the demand equation:

$$P^* = 50 - \left(\frac{1}{60}\right)1,200 = 50 - 20 = \$30$$

b. The monopolists profit at $P^* = \$30$ and $Q^* = 1{,}200$ is

$$\pi^* = TR - TC = P^*Q^* - \left(100 + 5Q^* + \left(\frac{1}{480}\right)Q^{*2}\right)$$

$$= 30(1,200) - \left[100 + 5(1,200) + \left(\frac{1}{480}\right)(1,200)^2\right] = \$26,900$$

Problem 8.9. Explain why a profit-maximizing monopolist would never produce at an output level (and charge a price) that corresponded to the inelastic portion of a linear market demand curve.

Solution. In the case of a linear market demand curve, when demand is elastic ($\varepsilon_p < -1$), marginal revenue is positive ($MR > 0$) and total revenue is increasing. When the price elasticity of demand is unitary ($\varepsilon_p = -1$), marginal revenue is zero ($MR = 0$) and total revenue is maximized. Finally, when the price elasticity of demand is inelastic ($-1 < \varepsilon_p < 0$), marginal revenue is negative ($MR < 0$) and total revenue is decreasing. Thus, if the monopolist were to produce at an output level corresponding to the inelastic portion of the demand curve, the corresponding marginal revenue would be negative. Since profit is maximized where $MR = MC$, this would imply that $MC < 0$, which is false by assumption. In other words, since total cost is assumed to be an increasing function of total output, then marginal cost cannot be negative, and a profit-maximizing monopolist would not produce where $MC = MR$.

MONOPOLY AND THE PRICE ELASTICITY OF DEMAND

Consider the relationship between the price charged by a profit-maximizing monopolist and the price elasticity of demand. From Equation (8.2)

$$\frac{d\pi(Q)}{dQ} = \frac{dTR(Q)}{dQ} - \frac{dTC(Q)}{dQ} = 0 \tag{8.2}$$

Recall that because the monopolist faces a downward-sloping demand curve, price is functionally related to output. Thus, Equation (8.2) may be rewritten as

$$\frac{d\pi(Q)}{dQ} = P + Q\left(\frac{dP}{dQ}\right) - MC = 0 \tag{8.10}$$

Rearranging the right-hand side of Equation (8.10) we obtain

$$-Q\left(\frac{dP}{dQ}\right) = P - MC \tag{8.11}$$

Dividing both sides of Equation (8.11) by P, we write

$$\left(-\frac{Q}{P}\right)\left(\frac{dP}{dQ}\right) = \frac{P - MC}{P}$$

$$\frac{-1}{\varepsilon_P} = \frac{P - MC}{P} \tag{8.12}$$

The profit-maximizing monopolist produces where $MR = MC$. Since marginal cost is normally positive, the left-hand side of Equation (8.12) implies that $-1 \leq \varepsilon_p < -\infty$; that is, demand is price elastic. Thus, a monopolist will produce, and price, along the elastic portion of the demand curve.

LERNER INDEX

Equation (8.12) is referred to as the *Lerner index*. The Lerner index, which is simply the negative of the inverse of the price elasticity of demand, is a measure of monopoly power and takes on values between 0 and 1. The greater the difference between price and marginal cost (marginal revenue) for a profit-maximizing firm, the greater the value of the Lerner index, and thus the greater the monopoly power of the firm. This result also suggests that the more elastic (flatter) the demand curve, the smaller will be the firm's proportional markup over marginal cost. A special case of the Lerner index is the case of a profit-maximizing, perfectly competitive firm where $P = MC$. The reader will verify that in this case the value of the Lerner index is 0 (i.e., no monopoly power).

Definition: The Lerner index is a measure of the monopoly power of a firm.

Problem 8.10. The market-determined price in a perfectly competitive industry is $P = \$10$. The total cost equation of an individual firm in this industry is

$$TC = 100 + 6Q + Q^2$$

Calculate the value of the Lerner index for this firm.

Solution. The profit equation for this firm is

$$\pi = TR - TC = 10Q - (100 + 6Q + Q^2) = -100 + 4Q - Q^2$$

Assuming that the second-order condition is satisfied, the profit-maximizing output level is found by taking the first derivative of the total profit function, setting the results equal to zero, and solving for Q.

$$\frac{d\pi}{dQ} = 4 - 2Q = 0$$

$$Q^* = 2$$

Marginal cost of this firm at $Q^* = 2$ is

$$MC = \frac{dTC}{dQ} = 6 + 2Q = 6 + 2(2) = 10$$

Thus, the value of the Lerner index is

$$\frac{-1}{\varepsilon_P} = \frac{P - MC}{P} = \frac{10 - 10}{10} = \frac{0}{10} = 0$$

Thus, this perfectly competitive firm has no monopoly power. The firm's proportional markup over marginal cost is zero; that is, the firm is earning zero economic profit.

Problem 8.11. The demand equation for a product sold by a monopolist is

$$P = 10 - Q$$

The total cost equation of the firm is

$$TC = 100 + 6Q + Q^2$$

Calculate the value of the Lerner index for this firm.

Solution. The profit equation for this firm is

$$\pi = TR - TC = PQ - TC = (10 - Q)Q - (100 + 6Q + Q^2) = -100 + 4Q - 2Q^2$$

Assuming that the second-order condition is satisfied, the profit-maximizing output level is found by taking the first derivative of the total profit function, setting the results equal to zero, and solving for Q.

$$\frac{d\pi}{dQ} = 4 - 4Q = 0$$

$$Q^* = 1$$

Substituting this into the demand equation gives the profit-maximizing price

$$P^* = 10 - Q = 10 - 1 = 9$$

Marginal cost of this firm at $Q^* = 1$ is

$$MC = \frac{dTC}{dQ} = 6 + 2Q = 6 + 2(1) = 8$$

Thus, the value of the Lerner index is

$$\frac{-1}{\varepsilon_P} = \frac{P - MC}{P} = \frac{9 - 8}{8} = \frac{1}{8} = 0.125$$

Thus, this firm enjoys monopoly power. The firm's proportional markup over marginal cost is 11.1%; that is, the firm is earning positive economic profit.

EVALUATING PERFECT COMPETITION AND MONOPOLY

In closing this chapter a few words are in order about the societal implications of a market structure that is characterized as perfectly competitive versus one that is dominated by a monopolist. In the case of a perfectly competitive output market, the equilibrium price and quantity are determined through the interaction of supply and demand forces. In Figure 8.11, the equilibrium price and quantity are determined at point *E*. At that point the equilibrium price and quantity in a perfectly competitive market are P_{pc} and Q_{pc}, respectively. In the case of a market dominated by a single producer, however, the equilibrium price and quantity are determined where $MC = MR$. In Figure 8.11 the equilibrium price and quantity are P_m and Q_m, respectively. From society's perspective, perfect competition is clearly preferable to monopoly because it results, even in the short run, in greater output and lower prices. This is not, however, the end of the story.

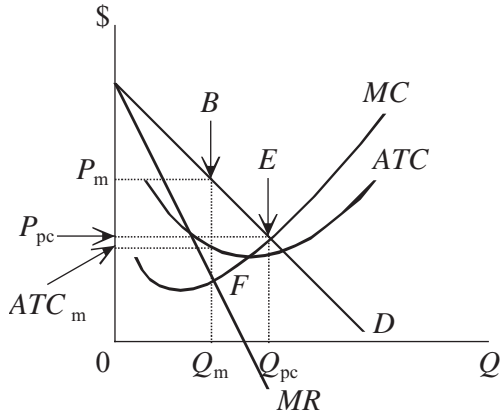

FIGURE 8.11 Evaluating monopoly and perfect competition.

In Figure 8.11 both the monopolist and the perfectly competitive firm are making economic profits. Unlike the case of an industry comprising a single producer, however, this situation will set into motion competitive forces that will eventually drive down prices and increase output further in markets that are characterized as perfectly competitive. Consider Figure 8.12.

As the lure of economic profit attracts new firms into the perfectly competitive industry, the market supply curve shifts to the right. As discussed earlier, long-run competitive equilibrium will be established where demand equals supply at point E'. At this point the typical firm in a perfectly competitive industry is making only normal profits. Since firms will no longer be attracted into the industry or compelled to leave it, the long-run competitive equilibrium price and quantity are P_{pc}' and Q_{pc}', respectively. For the monopolist, however, since new firms may neither enter nor exit the industry, equilibrium continues to be determined at point F and the long-run (and short-run) price and quantity remain P_m and Q_m, respectively. Clearly in this idealized case, society is better off when output is generated by perfectly competitive industries.

Monopolists are also less efficient than perfectly competitive firms, as an examination of Figure 8.12 illustrates. In long-run competitive equilibrium, the selling price of the product is equal to minimum cost per unit (i.e., $P_{pc}' = ATC_{min}$). In the case of an industry dominated by a monopolist, however, this is clearly not the case. At the profit-maximizing output level Q_m, the cost per unit of output is ATC_m. This solution is clearly inefficient and represents a misallocation of society's productive resources in the sense that not enough of the product is being produced. These results have profound implications for government-franchised monopolies, such as public utilities. At what price should the output of these firms be regulated? This

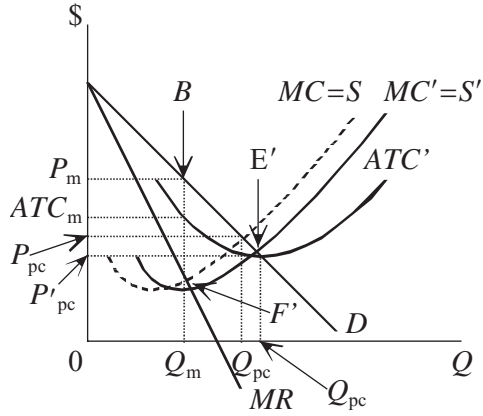

FIGURE 8.12 Long-run competitive equilibrium: perfect competition and monopoly.

question will be taken up in a later chapter. However, considerations of public welfare and efficiency should be central to regulators' concerns.

WELFARE EFFECTS OF MONOPOLY

Another approach to evaluating the relative merits of firms in perfectly competitive industries against those of a monopoly is by employing the concepts of consumer surplus and producer surplus.

CONSUMER SURPLUS

Consider Figure 8.13, which depicts the case of the perfectly competitive market. The area of the shaded region in the diagram $0AEQ^*$ represented the total benefits derived by consumers in competitive equilibrium. Total expenditures on Q^* units, however, is given by the area $0P^*EQ^*$. The difference between the total net benefits received from the consumption of Q^* units of output and total expenditures on Q^* units of output is given by the shaded area $0AEQ^* - 0P^*EQ^* = P^*AE$. *Consumer surplus* is given by the shaded area P^*AE. Consumer surplus is the difference between what consumers would be prepared to pay for a given quantity of a good or service and the amount they actually pay. The idea of consumer surplus is a derivation of the law of diminishing marginal utility. The law of diminishing marginal utility says that individuals receive incrementally less satisfaction from the consumption of additional units of a good or service and thus pay less for those additional units. Thus, in Figure 8.10, consumers are willing to pay more than P^* for the first unit of Q, but are prepared to pay just P^* for the Q^*th unit.

Definition: Consumer surplus is the difference between what consumers are willing to pay for a given quantity of a good or service and the amount

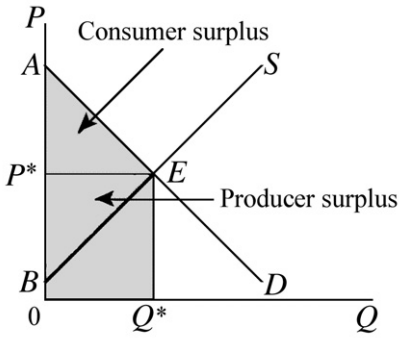

FIGURE 8.13 Consumer and producer surplus.

that they actually pay. Diagrammatically, consumer surplus is illustrated as the area below a downward-sloping demand curve but above the selling price.

PRODUCER SURPLUS

Consider, again, Figure 8.13. Recalling that the firm's supply curve is the marginal cost curve above minimum average variable cost, the total cost of producing Q^* units of output is given by the area $0BEQ^*$. Total revenues (consumer expenditures) earned from the sale of Q^* units of output is given by the area $0P^*EQ^*$. The difference between the total revenues from the sale of Q^* and the total cost of producing Q^* (total economic profit) is given by the shaded area $0BEQ^* - 0P^*EQ^* = BP^*E$. The shaded area BP^*E is referred to as *producer surplus*. Producer surplus is the difference between the total revenues earned from the production and sale of a given quantity of output and what the firm would have been willing to accept for the production and sale of that quantity of output.

Definition: Producer surplus is the difference between the total revenues earned from the production and sale of a given quantity of output and what the firm would have been willing to accept for the production and sale of that quantity of output.

PERFECT COMPETITION

It is often suggested in the economic literature that perfect competition is the "ideal" market structure because it guarantees that the "right" amount of a good or service is being produced. This is because the profit-maximizing firm will increase production up to the point at which marginal revenue (price) equals marginal cost. In this context, the demand curve for a good or service is society's marginal benefit curve. In a perfectly competitive market, output will expand until the marginal benefit derived by consumers, as evaluated along the demand function, is just equal to the marginal opportunity cost to society of producing the last unit of output. This is illustrated at point E in Figure 8.13. A voluntary exchange between consumer and producer will continue only as long as both parties benefit from the transaction. In the long run, perfectly competitive product markets guarantee that productive resources have been efficiently allocated and that production occurs at minimum cost.

Another way to evaluate a perfectly competitive market structure is to examine the relative welfare effects. Point E in Figure 8.13 also corresponds to the point at which the sum of consumer and producer surplus is maximized. The reader will note that no attempt is made to moralize about the relative virtues of consumers and producers. Perfect competition is consid-

ered to be a superior market structure precisely because perfect competition maximizes total societal benefits.

MONOPOLY

If it is, indeed, true that perfect competition is the "ideal" market structure because it results in the "right" amount of the product being produced, how are we to assess alternative market structures? It is, of course, tempting to condemn monopolies as avaricious, self-serving, or immoral, but are these characterizations justified? After all, profit-maximizing, perfectly competitive firms follow precisely the same decision criterion as the monopolist: that is, $MR = MC$. Viewed in this way, it is difficult to sustain the argument that the evils of monopolies reside in the hearts of monopolists.

To evaluate the relative societal merits of perfect competition versus monopoly, a more objective standard must be employed. We may infer, for example, that a monopolist earning economic profit benefited at the expense of consumers. We have already noted that consumers are made worse off because monopolists charge a higher price and produce a lower level of output than would be the case with perfect competition. We have also noted that monopolies are inherently inefficient because monopolists do not produce at minimum per unit cost. The real issue is whether the gain by monopolists in the form of higher profits is greater than, less than, or equal to the loss to consumers paying a higher price from a lower level of output. If the gain by monopolists is equal to the loss by consumers, it will be difficult to objectively argue that society is worse off because of the existence of monopolies. After all, monopolists are people too.

There are a number of reasoned economic arguments favoring perfect competition over monopoly. One such argument involves the application of the concepts of consumer and producer surplus. Consider Figure 8.14, which illustrates the situation of a profit-maximizing monopolist. For ease of exposition, the marginal cost curve is assumed to be linear.

In the case of perfect competition, equilibrium price and quantity are determined by the intersection of the supply (marginal cost) and demand (marginal benefit) curves. In Figure 8.14 this occurs at point E. The equilibrium price and quantity are P^* and Q^*, respectively. As in Figure 8.13, consumer surplus is given by the area P^*AE and producer surplus is given by the area BP^*E. The sum of consumer and producer surplus is given by the area BAE.

Suppose that the industry depicted in Figure 8.14 is transformed into a monopoly. A monopolist will maximize profits by producing at the output level at which $MR = MC$. The monopolist in Figure 8.14 will produce Q_m units of output and charge a price of P_m. The reader will verify that under monopoly the consumer is paying a higher price for less output. The reader will also verify that consumer surplus has been reduced from P^*AE to

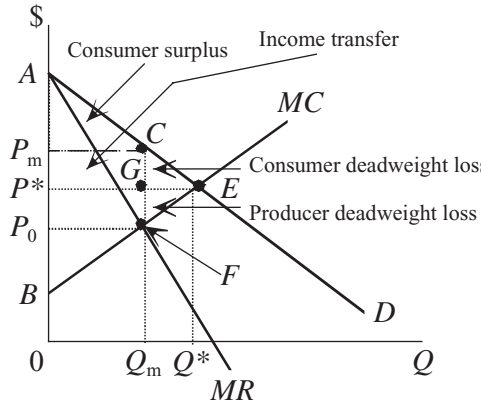

FIGURE 8.14 Consumer and producer deadweight loss.

P_mAC. Clearly, the consumer has been made worse off as a result of the monopolization of this industry by the area P^*P_mCE. To what extent has the monopolist benefited at the expense of the consumer?

An examination of Figure 8.14 clearly indicates that producer surplus has changed from the area BP^*E to BP_mCF. The net change in producer surplus is $P^*P_mCG - FGE$. The portion of lost consumer surplus P^*P_mCE captured by the monopolist (P^*P_mCE) represents an income transfer from the consumer to the producer. If the net change in producer surplus is positive, then the producer has been made better off as a result of the monopolization of the industry. Certainly, in terms of Figure 8.14, this appears to be the case, but is society better off or worse off? To see this we must compare the sums of consumer and producer surpluses before and after monopolization of the industry.

Before the monopolization of the industry, net benefits to society are given by the sum of consumer and producer surplus, $P^*AE + BP^*E = BAE$. After monopolization of the industry the net benefits to society are given by the sum of consumer and producer surplus $P_mAC + BP_mCF = BACF$. Since $BACF < BAE$, society has been made worse off as a result of monopolization of the industry.

DEADWEIGHT LOSS

The reader should note that in Figure 8.14 the portion of lost consumer and producer surplus is given by the area $GCE + FGE = FCE$. The area FCE is referred to as *total deadweight loss*. The area GCE is referred to as *consumer deadweight loss*. Consumer deadweight loss represents the reduction in consumer surplus that is not captured as an income transfer to a monopolist. The area FGE is referred to as *producer deadweight loss*. Pro-

ducer deadweight loss arises when society's resources are inefficiently employed because the monopolist does not produce at minimum per-unit cost. No assumptions about the relative merits of consumers or producers or the distribution of income are required to assess this outcome. Clearly, the loss of consumer and producer surplus represents a net loss to society.

Definition: Consumer deadweight loss represents the reduction in consumer surplus that is not captured as an income transfer to a monopolist.

Definition: Producer deadweight loss arises when society's resources are inefficiently employed because the monopolist does not produce at minimum per-unit cost.

Definition: Total deadweight loss is the loss of consumption and production efficiency arising from monopolistic market structures. Total deadweight loss is the sum of the losses of consumer and producer surplus for which there are no offsetting gains.

The importance of the foregoing analysis of the welfare effects of monopoly for public policy cannot be underestimated. Demands by public interest groups for remedies against the "abuses" of monopolies are seldom framed in terms of total deadweight loss, and indeed focus on the unfairness of the transfer, with monopoly pricing of income from consumer to producer, (i.e., the net loss of consumer surplus). But as we have seen, part of this loss of consumer surplus is captured by the monopolist in the form of an income transfer. It is important, however, to question the disposition of income transfers before categorically condemning monopolistic pricing and output practices.

Monopolistic market structures that result in increased research and development, such as product invention and innovation, may be considered to be socially preferable to the rough-and-tumble of perfect competition. An example of this is monopolies arising from patent protection that results in the development of lifesaving pharmaceuticals. Another example of a monopoly that is considered to be socially desirable is that of the government franchise, which was also discussed earlier. The static analysis of the welfare effects of monopoly ignores the dynamic implications of monopolistic market structures. The dynamic implications must also be considered when one is evaluating the relative benefits of perfect competition versus monopoly.

Problem 8.12. Consider the monopolist that faces the following market demand and total cost functions:

$$Q = 22 - \frac{P}{5}$$

$$TC = 100 - 10Q + Q^2$$

a. Find the profit-maximizing price (P_m) and output (Q_m) for this firm. At this price–quantity combination, how much is consumer surplus?

b. How much economic profit is this monopoly earning?
c. Given your answer to part a, what, if anything, can you say about the redistribution of income from consumer to producer?
d. Suppose that government regulators required the monopolist to set the selling price at the long-run, perfectly competitive rate. At this price, what is consumer surplus?
e. Relative to the perfectly competitive long-run equilibrium price, what is the deadweight loss to society at P_m?

Solution

a. The total revenue function for the monopolist is

$$TR = PQ = 110Q - 5Q^2$$

The monopolist's total profit function is therefore

$$\pi = -100 + 120Q - 6Q^2$$

Taking the first derivative of this expression yields the profit maximizing output level

$$\frac{d\pi}{dQ} = 120 - 12Q = 0$$

$$Q_m = 10$$

The profit-maximizing price is, therefore

$$P_m = 110 - 5Q_m = 110 - 5(10) = 60$$

Consumer surplus may be determined from the following expression:

$$\text{Consumer surplus} = 0.5(110 - P_m)Q_m$$

where 110 is the price according to the demand function when $Q = 0$. Utilizing this expression yields

$$\text{Consumer surplus} = 0.5(110 - 60)10 = \$250$$

b. The monopolist economic profit is

$$\pi = -100 + 120Q - 6Q^2 = -100 + 120(10) - 6(102) = \$500$$

which is the amount of the income transfer from consumer to producer.
c. Unfortunately, economic theory provides no insights about whether this income transfer is an improvement in society's welfare. Such an analysis would require an assumption about the appropriate distribution for the society in question, and this cannot be evaluated by using efficiency criteria.
d. The perfectly competitive long-run equilibrium price is defined as

$$P = MC = ATC$$

Marginal cost is equal to average total cost at the output level where average total cost is minimized. Define average total cost as

$$ATC = 100Q^{-1} - 10 + Q$$

Taking the first derivative and setting the results equal to zero yields

$$\frac{dATC}{dQ} = -100Q^{-2} + 1 = 0$$

$$Q^* = 10$$

Alternatively, setting $MC = ATC$ yields

$$-10 + 2Q = 100Q^{-1} - 10 + Q$$
$$Q^2 = 100$$
$$Q = 10$$

At this output level, the long-run, perfectly competitive price is

$$P_{pc} = -10 + 2Q = -10 + 2(10) = 10$$

with an output level of

$$Q_{pc} = 22 - \frac{P}{5} = 22 - \frac{10}{5} = 20$$

In this case, consumer surplus may be determined from the following expression:

$$\text{Consumer surplus} = 0.5(110 - P_{pc})Q_{pc} = 0.5(110 - 10)20 = \$1{,}000$$

e. Finally, the deadweight loss to society is

$$\text{Deadweight loss} = 0.5[(P_m - P_{pc})(Q_{pc} - Q_m)]$$
$$= 0.5[(60 - 10)(20 - 10)] = \$250$$

This solution is illustrated in Figure 8.15.

NATURAL MONOPOLY

At the beginning of the discussion about the existence of monopolies, the focus was on such barriers to entry as control over scarce productive resources, patent rights, and government franchises. In each instance, monopoly power was based on exclusive access or special privilege. It is conceivable, however, that a firm may come to dominate a market based on the underlying production technology. In particular, if a single firm is able to realize sufficiently large economies of scale such that alone it can satisfy total market demand at a per-unit cost that is less than an industry

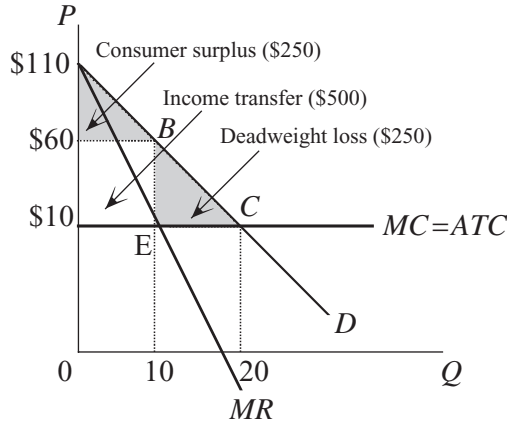

FIGURE 8.15 Diagrammatic solution to problem 8.2, part e.

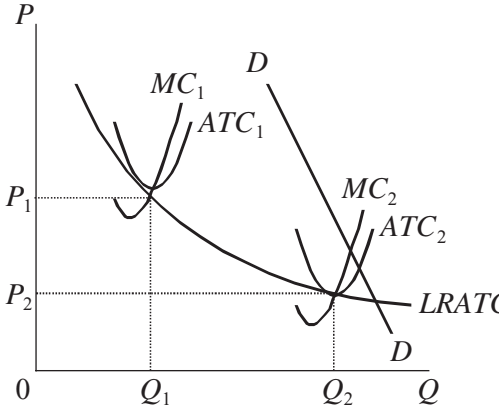

FIGURE 8.16 Natural monopoly and economies of scale.

consisting of two or more firms, then that firm is referred to as *natural monopoly*.

Definition: A natural monopoly is a firm that is able to satisfy total market demand at a per-unit cost of production that is less than an industry comprising two or more firms.

The case of a natural monopoly is illustrated in Figure 8.16, where the MC_1 and ATC_1 curves designate a small-scale plant and MC_2 and ATC_2 a large-scale plant. Suppose that Q_2 represents an output level of 250,000 units and Q_1 represents an output level of 50,000 units. Clearly, it would be more efficient, less costly, and in the public interest for one firm to operate a single large-scale plant than for five firms to operate several small-scale

plants. This is, in fact, one rationale underlying the granting of government franchises of public utilities.

COLLUSION

Suppose that an industry initially comprised several firms, which decided to coordinate their pricing and output decisions to limit competition and maximize profits for the group. Such an arrangement is referred to as *collusion*. Analytically, the impact on the consumer would be the same as in the case of a monopoly. In the United States, collusive arrangements are illegal. Collusive pricing and output behavior by firms will be more closely examined in Chapter 10 (Market Structure: Duopoly and Oligopoly) and Chapter 13 (Introduction to Game Theory).

Definition: Collusion refers to a formal agreement among producers in an industry to coordinate pricing and output decisions to limit competition and maximize collective profits.

CHAPTER REVIEW

Market structure refers to the competitive environment within which a firm operates. Economists divide market structure into four basic types: *perfect competition*, *monopolistic competition*, *oligopoly*, and *monopoly*. Perfect competition and monopoly represent opposite ends of the competitive spectrum.

The characteristics of a perfectly competitive industry are a large number of sellers and buyers, a standardized product, complete information about market prices, and complete freedom of entry into and exit from the industry. A perfectly competitive firm produces a minuscule proportion of the total industry output. Thus, although the market demand curve is downward sloping, the demand curve from the perspective of the individual firm is perfectly elastic (horizontal). A perfectly competitive firm can sell as much as it wants at an unchanged price. A perfectly competitive firm has no *market power*, and is said to be a *price taker*.

Total revenue is defined as price (P) times output. *Marginal revenue* (MR) is defined as the increase (decrease) in total revenue given an increase (decrease) in output. For a perfectly competitive firm, marginal revenue is identically equal to the selling price. Since, $MR = P$, then $MR = ATR$ (average total revenue).

All profit-maximizing firms produce at an output level at which marginal revenue equals marginal cost (MC), that is, $MR = MC$. Since $MR = P_0$, the profit-maximizing condition for a perfectly competitive firm is $P_0 = MC$. If price is greater than average total cost ($P_0 > ATC$), then a perfectly competitive firm earns positive economic profits, which will attract new firms

into the industry, shifting the market supply curve to the right and driving down the selling price. If $P_0 < ATC$, the firm generates economic losses, which cause firms to exit the industry, shifting the market supply curve to the left and driving up the selling price. When $P_0 = ATC$, a perfectly competitive firm breaks even (i.e., earns zero economic profits). At this *break-even price*, the industry is in long-run competitive equilibrium, which implies that $P_0 = MC = ATC$. Finally, since $MC = ATC$, per-unit costs are minimized; that is, perfectly competitive firms produce efficiently in the long run.

In the short run, a perfectly competitive firm earning an economic loss will remain in business as long as price is greater than average variable cost (AVC). This is because the firm's revenues cover all its fixed cost and part of its variable cost. When $P_0 < AVC$, the firm will shut down because revenues cover only part of its variable cost and none of its fixed cost. When $P_0 = AVC$, the firm is indifferent between shutting down and remaining in business. This is because in either case the firm's economic loss is equivalent to its total fixed cost. This price is called the *shutdown price*.

The characteristics of a monopolistic industry are a single firm, a unique product, absolute control over supply within a price range, and highly restrictive entry into or exit from the industry. Unlike the perfectly competitive firm, a monopoly faces the downward-sloping market demand curve, which implies that the selling price is negatively related to the output of the firm. A monopolist has market power and is said to be a *price maker*.

A profit-maximizing monopolist will produce at an output level at which $MR = MC$. Unlike a perfectly competitive firm, selling price is always greater than the marginal revenue (i.e., $P > MR$). Like a perfectly competitive firm, the monopolist earns an economic profit when $P > ATC$. Unlike a perfectly competitive firm, this condition is both a short-run and a long-run competitive equilibrium, since new firms are unable to enter the industry to increase supply, lower selling price, and compete away the monopolist's economic profits. Finally, since $MC < ATC$, per-unit costs are not minimized; that is, monopolists produce inefficiently in the long run.

A *natural monopoly* is a firm that is able to satisfy total market demand at a per-unit cost of production that is less than an industry comprising two or more firms. *Collusion* refers to a formal agreement among producers in an industry to coordinate pricing and output decisions to limit competition and maximize collective profits. Collusive arrangements are illegal in the United States.

KEY TERMS AND CONCEPTS

Break-even price The price at which total revenue is equal to total economic cost.

Collusion A formal agreement among producers in an industry to coordinate pricing and output decisions to limit competition and maximize collective profits.

Consumer deadweight loss The reduction in consumer surplus that is not captured as an income transfer to a monopolist.

Consumer surplus The difference between what consumers are willing to pay for a given quantity of a good or service and the amount that they actually pay. Diagrammatically, consumer surplus is illustrated as the area below a downward-sloping demand curve but above the selling price.

Economic cost The sum of total explicit and implicit costs.

Economic loss Total revenue that is less than total economic cost.

Economic profit Total revenue that is greater than total economic cost.

Government franchise A publicly authorized monopoly.

Lerner index A measure of the monopoly power of a firm.

Market power The ability of a firm to influence the market price of its product by altering its level of output. Market power is displayed when a firm produces a significant proportion of total industry output.

Market structure The environment within which buyers and sellers interact.

Monopoly The market structure in which there is only one producer of a good or service for which there are no close substitutes and entry into and exit from the industry is impossible.

MR = MC Marginal revenue equals marginal cost is the first-order condition for profit maximization by firms in imperfectly competitive markets.

***MR = P*$_0$** Marginal revenue equals price for firms in perfectly competitive industries.

Natural monopoly A firm that is able to satisfy total market demand at a per-unit cost of production that is less than an industry comprising two or more firms.

P*$_0$ *= MC Price equals marginal cost is the first-order condition for profit maximization by perfectly competitive firms.

P*$_0$ *= MC = ATC Price equals marginal cost equals minimum average total cost is the first-order, long-run profit-maximizing condition for perfectly competitive firms.

P > MR = MC The selling price is greater than marginal revenue, which is equal to marginal cost, is the first-order profit maximizing condition for a firm facing downward-sloping demand curve for its good or service.

Patent The exclusive right granted to an inventor by government to a product or a process.

Perfect competition The market structure in which there are many buyers and sellers of a homogeneous good or service; in addition, there is perfect mobility of factors of production and buyers, sellers have perfect infor-

mation about market conditions, and entry into and exit from the industry is very easy.

Price maker A firm that faces a downward-sloping demand curve for its product. This condition implies that the firm is able to alter the market price of its product by changes its output level.

Price taker A perfectly competitive firm that prices its good or service at the prevailing market price. A perfectly competitive firm is called a price taker because it is unable to influence the market price of its product by altering its level of output. This condition implies that a perfectly-competitive firm should be able to sell as much of its good or service at the prevailing market price as any other comparable firm.

Producer deadweight loss Arises when society's resources are inefficiently employed because a monopolist does not produce at minimum per-unit cost.

Producer surplus The difference between the total revenues earned from the production and sale of a given quantity of output and what the firm would have been willing to accept for the production and sale of that quantity of output.

Shutdown price The price that is equal to the minimum average variable cost of producing a good or service. Below this price the firm will shut down because the firm's loss, which will equal the firm's total fixed cost, will be less than if the firm continues to stay in business.

Total deadweight loss The loss of consumption and production efficiency arising from monopolistic market structures. Total deadweight loss is the sum of the losses of consumer and producer surpluses for which there are no offsetting gains.

Total fixed cost The firm's expenditures on fixed factors of production.

Total variable cost The firm's expenditures on variable factors of production.

CHAPTER QUESTIONS

8.1 Price competition is characteristic of firms in perfectly competitive industries. Do you agree with this statement? If not, then why not?

8.2 Firms in perfectly competitive industries may be described as price takers. What are the implications of this observation for the price and output decisions of profit-maximizing firms?

8.3 For industries characterized as perfectly competitive, equilibrium price and quantity can never be determined along the inelastic portion of the market demand curve. Do you agree? Explain.

8.4 A perfectly competitive firm earning an economic loss at the profit-maximizing level of output should shut down. Do you agree with this statement? Explain.

8.5 A profit-maximizing firm is producing at an output level at which the price of its product is less than the average total cost of producing that product. Under what conditions will this firm continue to operate? Explain.

8.6 A profit-maximizing firm is producing at an output level at which the price of its product is less than the average total cost of producing that product. Under what conditions will this firm shut down? Explain.

8.7 A perfectly competitive firm in short-run competitive equilibrium must also be in long-run competitive equilibrium. Do you agree? Explain.

8.8 A perfectly competitive firm in long-run competitive equilibrium must also be in short-run competitive equilibrium. Do you agree? Explain.

8.9 A perfectly competitive firm in long-run competitive equilibrium earns a zero rate of return on investment. Do you agree? If not, then why not?

8.10 No firm in a perfectly competitive industry would ever operate at a point on the demand curve at which the price elasticity of demand is equal to or less than one in absolute value. Comment.

8.11 No competitive industry would ever operate at a point on the industry demand curve at which the price elasticity of demand is equal to or less than one in absolute value. Comment.

8.12 A perfectly competitive firm in long-run competitive equilibrium produces at minimum per-unit cost. Do you agree? Explain.

8.13 A perfectly competitive firm maximizes profits by producing at an output level at which marginal revenue equals declining marginal cost. Do you agree? If not, then why not?

8.14 A perfectly competitive firm will continue to operate in the short run as long as total revenues cover all the firm's total variable costs and some the firm's total fixed costs. Explain.

8.15 The marginal cost curve is a perfectly competitive firm's supply curve. Do you agree with this statement? If not, then why not?

8.16 In a perfectly competitive industry, the market supply curve is the summation of the individual firm's marginal cost curves. Do you agree? Explain.

8.17 When price is greater than average variable cost for a typical firm in a perfectly competitive industry, we can be quite certain that the price will fall. Explain.

8.18 A profit-maximizing monopolist will never produce along the inelastic portion of the market demand curve. Do you agree? Explain.

8.19 To maximize total revenue, the monopolist must charge the highest price possible. Do you agree? Explain.

8.20 Suppose that an unregulated electric utility is a government-franchised, profit-maximizing monopoly. At the prevailing price of electricity, an empirical study indicates that the price elasticity of demand for electricity is –0.8. Something is wrong. What? Explain.

8.21 A monopolist does not have a supply curve. Explain.

8.22 For a profit-maximizing firm subject to the law of diminishing marginal product, maximizing total revenue is equivalent to maximizing total profit. Do you agree? Explain.

8.23 Under what circumstances will maximizing the firm's total revenues result in maximum total profits.

8.24 Indicate whether the following statements are true, false, or uncertain. Explain.

a. A profit-maximizing monopoly charges the highest price possible for its product.
b. Profit-maximizing monopolies are similar to profit-maximizing perfectly competitive firms in that $P_0 = MR$.
c. It is possible to describe the market demand for the output of a perfectly competitive industry as price inelastic.
d. It is possible to describe the market demand for the output of a profit-maximizing monopolist as price inelastic.
e. Suppose that a monopolist employs only one factor of production and that marginal and average total cost are constant. A 10% increase in the price of that input will cause the monopolist to increase product price by 10%.
f. Suppose that a profit-maximizing monopolist can shift the linear demand curve for the firm's product to the right by advertising. The monopolist's total cost equation is $TC = \theta Q$, where θ is a positive constant. An increase in the price of advertising will result in an increase in the price of the monopolist's output.

8.25 The Lerner index is a measure of a firm's monopoly power. It is also a measure of the firm's per-unit proportional markup over marginal cost. Explain.

8.26 Describe the social welfare effects of monopolies versus those of perfect competition.

8.27 Compared with perfect competition, for consumers monopolies are always and inferior market structure. Do you agree? If not, then why not?

8.28 Why do governments grant patents and copyrights?

CHAPTER EXERCISES

8.1 A firm faces the following total cost equation for its product

$$TC = 500 + 5Q + 0.025Q^2$$

The firm can sell its product for \$10 per-unit of output.

a. What is the profit-maximizing output level?
b. Verify that the firm's profit corresponding to this level of output represents a maximum.

8.2 The total cost (TC) and demand equations for a monopolist is

$$TC = 100 + 5Q^2$$

$$P = 200 - 5Q$$

a. What is the profit-maximizing quantity?
b. What is the profit-maximizing price?

8.3 Bucolic Farms, Inc., is a dairy farm that supplies milk to B&Q Foodstores, Inc. Bucolic has estimated the following total cost function

$$TC = 100 + 12Q + 0.06Q^2$$

where Q is 100 gallons of milk.

a. Determine the following functions:
   i. Average total cost (ATC)
   ii. Average variable cost (AVC)
   iii. Marginal cost (MC)
   iv. Total fixed cost (TFC)
b. What are Bucolic's shutdown and break-even price and output levels?
c. Suppose that there are 5,000 nearly identical milk producers in this industry. What is the market supply curve?
d. Suppose that the market demand function is

$$Q_D = 660,000 - 16,333,33P$$

   What are the market equilibrium price and quantity?
e. Determine Bucolic's profit.
f. Assuming no change in demand or costs, how many milk producers will remain in the industry in the long run?

8.4 A monopoly faces the following demand and total cost equations for its product.

$$Q = 30 - \frac{P}{3}$$

$$TC = 100 - 5Q + Q^2$$

a. What are the firm's short-run profit-maximizing price and output level?
b. What is the firm's economic profit?

8.5 The demand equation for a product sold by a monopolist is

$$Q = 25 - 0.5P$$

The total cost equation of the firm is

$$TC = 225 + 5Q + 0.25Q^2$$

a. Calculate the profit-maximizing price and quantity.
b. What is the firm's profit?

8.6 The market equation for a product sold by a monopolist is

$$Q = 100 - 4P$$

The total cost equation of the firm is

$$TC = 500 + 10Q + 0.5Q^2$$

a. What are the profit-maximizing price and quantity?
b. What is the firm's maximum profit?

8.7 A firm faces the following total cost equation for its product

$$TC = 6 + 33Q - 9Q^2 + Q^3$$

The firm can sell its product for $18 per-unit of output.

a. What is the profit-maximizing output level?
b. What is the firm's profit?

8.8 Suppose initially that the blodget industry in Ancient Elam is in long-run competitive equilibrium, with each firm in the industry just earning normal profits. This situation is illustrated in Figure E8.8.

a. Find the equilibrium price and the industry output level.
b. Suppose that venture capitalists organize a syndicate to acquire all the firms in the blue blodget industry. The resulting company, Kablooy, is a profit-maximizing monopolist. Find the equilibrium price and output level. What is the monopolist's economic profit?
c. Suppose that the Antitrust Division of the U.S. Department of Justice is concerned about the economic impact of consolidation in the blue blodget industry but is generally of the opinion that it is not in the national interest to "break up" Kablooy. Instead, Justice Department lawyers recommend that the blue blodget industry be regulated. In your opinion, what are the economic concerns of Justice Department? In your answer, explain whether consumers were made better off or worse off as a result of consolidation in the blue blodget industry?

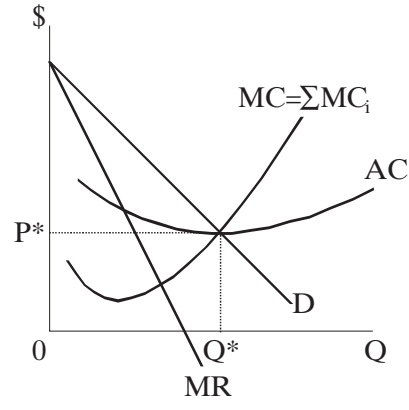

FIGURE E8.8 Chapter exercise 8.8.

Also, be sure to compare prices, output levels, production efficiency, and consumer surplus before and after consolidation.

d. If you believe that consumers have been made worse off, what regulatory measures would you suggest be recommended by the Justice Department?
e. Do you foresee any potential long-run economic problems arising from the decision to allow the blue blodget industry from continuing as a monopoly (*Hint*: What are the implications for product innovation, development, and adoption of efficient production technology)?

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APPENDIX 8A

FORMAL DERIVATION OF THE FIRM'S SUPPLY CURVE

Suppose that the objective of the firm is to maximize the profit function

$$\pi(Q) = PQ - TC(Q) \tag{8A.1}$$

where Q represents the firm's output and the parameter P the market determined price of the product. The first-order condition for profit maximization is

$$P - MC(Q) = 0 \tag{8A.2}$$

where $MC = dTC/dQ$, the firm's marginal cost. Equation (8A.2) asserts that the firm will maximize profit by producing at an output level at which price equals marginal cost. The second-order condition for profit maximization is

$$\frac{d^2\pi}{dQ^2} = \frac{-d^2TC}{dQ^2} = \frac{-dMC}{dQ} < 0 \tag{8A.3}$$

Equation (8A.3) merely asserts that the marginal cost curve of the firm is upward sloping. An upward sloping marginal cost curve with the product price constant is a reflection of the law of diminishing marginal product.

In principle, Equation (8A.2) may be solved for Q in terms of P, that is,

$$Q = Q^*(P) \tag{8A.4}$$

Equation (8A.4) is the firm's supply function. The question, of course, is how the firm's output will change when as price varies. To see this, substitute Equation (8A.4) into Equation (8A.2) to yield

$$P - MC[Q^*(P)] \equiv 0 \tag{8A.5}$$

Note that Equation (8A.5) is an identity, since the left-hand side is always zero because the profit-maximizing firm will always set price equal marginal cost for any P. Differentiating Equation (8A.5) with respect to price, and using the chain rule (see Chapter 2), we obtain

$$\frac{dP}{dP} - \frac{dMC(Q)}{dQ}\frac{dQ^*}{dP} \equiv 0 \tag{8A.6}$$

which yields

$$\frac{dQ^*}{dP} \equiv \frac{1}{dMC(Q)/dQ} > 0 \tag{8A.7}$$

Since $(dMC(Q)/dQ) > 0$ by the second-order condition for profit maximization, this ends our proof.

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9

Market Structure: Monopolistic Competition

Although the conditions necessary for the existence of perfect competition and monopoly, which were discussed in Chapter 8, are unlikely to be found in the real world, an analysis of these market structures is important because it provides insights into more commonly encountered industry types. These insights provide guidance in the formulation of public policy to promote the general economic welfare. We saw in Chapter 8, for example, that unlike monopolies, perfectly competitive firms produce at minimum per-unit cost. Thus, perfectly competitive market structures efficiently allocate society's scarce productive resources and tend to maximize consumer and producer surplus. For these reasons, economists tend to favor policies that move industries closer to the perfectly competitive paradigm.

Despite the unlikelihood encountering the conditions that define perfect competition in reality, the insights gleaned from an analysis of this market structure yield important insights into real-world phenomena. As Milton Friedman (1981) observed: "I have become increasingly impressed with how wide is the range of problems and industries for which it is appropriate to treat the economy as if it were competitive" (p. 120). What is important is not that the characteristics that define perfect competition are religiously satisfied, but that in large measure the interactions of market participants simulate the competitive model.

Although models of perfect competition and monopoly are useful, it is important analytically to bridge the gap between these two extreme cases. The first significant contributions in this direction were provided by Edward Chamberlin and Joan Robinson. These economists observed that in many intensely competitive markets individual firms were able to set the market

price of their product. Since these firms exhibit characteristics of both perfect competition and monopoly, this market structure is referred to as *monopolistic competition*.

The market power of monopolistically competitive firms, such as fast-food restaurants, is derived from product differentiation and market segmentation. Through subtle and not-so-subtle distinctions, each firm in a monopolistically competitive industry is a sort of minimonopolist. But, unlike monopolists, these firms are severely constrained in their ability to set the market price for their product by the existence of many close substitutes. Thus, the demand for the output of monopolistically competitive firms is much more price elastic (flatter) than the demand curve confronting the monopolist. A firm in a perfectly competitive industry faces a perfectly elastic (horizontal) demand curve because its output is a perfect substitute for the output of other firms in the industry. Unlike monopolies and monopolistically competitive firms, which may be described as price makers, perfectly competitive firms are price takers.

CHARACTERISTICS OF MONOPOLISTIC COMPETITION

Monopolistic competition has characteristics in common with both perfect competition and monopoly. The most salient features of monopolistically competitive markets are as follows.

NUMBER AND SIZE DISTRIBUTION OF SELLERS

As in perfect competition, a monopolistically competitive industry is assumed to have a large number of firms, each producing a relatively small percentage of total industry output. As in perfect competition, the actions of any individual firm are unlikely to influence the actions of its competitors.

NUMBER AND SIZE DISTRIBUTION OF BUYERS

Also as in perfect competition, monopolistic competition assumes that there are a large number of buyers for its output and that resources are easily transferred between alternative uses.

PRODUCT DIFFERENTIATION

Unlike perfect competition, while each firm in a monopolistically competitive industry produces essentially the same type of product, each firm produces a product that is considered by consumers to be somewhat dif-

ferent from those of its competitors. The products of each firm in the industry are close, albeit not perfect, substitutes. Monopolistic competition is frequently encountered in the retail and service industries. Examples of product differentiation are most frequently encountered in the same industries and include such products as clothing, soft drinks, beer, cosmetics, gasoline stations, and restaurants.

Product differences may be real or imagined. For example, regular (87 octane) gasoline has a precise chemical composition. Many consumers, however, believe brand-name gasoline stations, such as Exxon and Mobile, sell better gasoline than little-known vendors. Firms often reinforce these perceived differences by introducing real or cosmetic additives into their product. Monopolistically competitive firms commit substantial sums in advertising expenditures to reinforce real and perceived product differences. These efforts are intended not only to attract new buyers but also to create brand-name recognition and solidify customer loyalty. By segmenting the market in this manner, these producers are able to charge higher prices. Within each segment of the market, the individual firm is a monopolist that is able to exercise market power.

CONDITIONS OF ENTRY AND EXIT

Finally, as in perfect competition, it is relatively easy for new firms to enter the industry, or for existing firms to leave it.

Definition: Monopolistic competition is a market structure that is characterized by buyers and sellers of a differentiated good or service and in which it is relatively easy to enter the industry or to leave it.

SHORT-RUN MONOPOLISTICALLY COMPETITIVE EQUILIBRIUM

Clearly, then, the one condition that differentiates the perfectly competitive firm from the monopolistically competitive firm is that the latter faces a downward-sloping demand curve for its product, which implies that, like a monopolist, the firm has some control over the selling price of its product. This market power stems from consumers' belief that each firm in the industry produces a somewhat different product, with different qualities and different customer appeal.

The typical firm's ability to affect the selling price of its product implies that the firm is able, within bounds, to raise the price of its product without completely losing its customer base. This situation is illustrated in Figure 9.1, which assumes the usual U-shaped marginal and average total cost curves.

In Figure 9.1, we observe that a typical monopolistically competitive firm maximizes its short-run profit by producing at the level of output at which

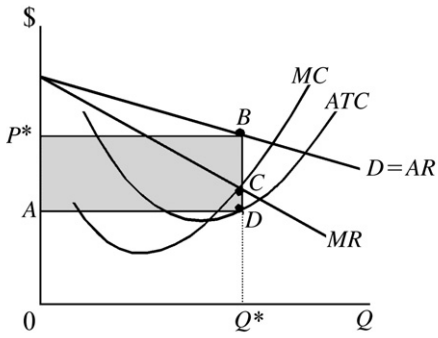

FIGURE 9.1 Short-run monopolistically competitive equilibrium and positive economic (above-normal) profit.

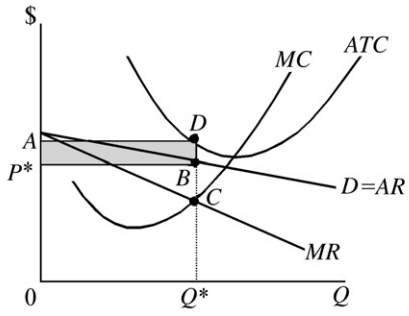

FIGURE 9.2 Short-run monopolistically competitive equilibrium and negative economic (below-normal) profit.

marginal cost equals marginal revenue. This occurs at the output level Q^*. At this output level, the firm charges a price of P^*, which is determined along the demand (average revenue) curve. The firm's total revenue is illustrated by the area of the rectangle $0P^*BQ^*$. The firm's total cost at output level Q^* is illustrated by the area of the rectangle $0ADQ^*$. Since total profit is defined as the difference between total revenue and total cost, the firm's profit at output level Q^* is illustrated by the area of the rectangle AP^*BD.

Of course, in the short run the monopolistically competitive firm might just as easily have generated an economic loss. This is illustrated by the area of the rectangle P^*ADB in Figure 9.2. Note, again, that profit is maximized at Q^*, where marginal cost equals marginal revenue.

LONG-RUN MONOPOLISTICALLY COMPETITIVE EQUILIBRIUM

Each firm in a monopolistically competitive industry produces a somewhat different version of the same product. The objective of product differentiation is market segmentation. By producing a product that is perceived to be different from those produced by every other firm in the

industry, firms in monopolistically competitive markets are able to carve out their own market niche. In doing so, each firm faces a downward-sloping demand curve for its product. Within a relatively narrow range of prices, each firm exercises a degree of market power by exploiting brand-name identification and customer loyalty.

There is, however, a limit to the ability of firms in a monopolistically competitive industry to exercise market power by exploiting customer loyalty. Since all firms produce fundamentally the same type of product, the demand for each firm's product is more price elastic because of the existence of many close substitutes. By contrast, there are not close substitutes for the output of a monopolist. Moreover, as more firms enter the market, the number of close substitutes increases, which not only reduces each firm's market share but also increases the price elasticity of demand for each firm's product.

The short-run analysis of the profit-maximizing, monopolistically competitive firm is similar to that of the monopolist, but that is where the similarity ends. Relatively easy entry into and exit from the industry guarantees that in the long run monopolistically competitive firms will earn zero economic profit. To see this, consider, again, the short-run monopolistically competitive equilibrium condition in Figure 9.1.

The opportunity to obtain positive economic profits attracts new firms into the industry. Each firm offers for sale in the market a product that is somewhat different from those of its competitors, which results in increased market segmentation. As a result, the demand curve firm not only shifts to the left (because each firm has a smaller market share), but also becomes more price elastic (because of an increase in the number of close substitutes). Conversely, as firms exit the industry in the face of economic losses, the market share of each firm increases and the demand curve shifts to the right and becomes less price elastic (because fewer substitutes are available to the consumer). As in the case of perfect competition, this process will continue until each firm earns zero economic (normal) profit. This final, long-run monopolistically competitive equilibrium, is illustrated in Figure 9.3.

In the long run, the demand curve of the monopolistically competitive firm is tangent to the average total cost curve at the profit-maximizing output level Q^*. At this output level, total revenue ($P^* \times Q^*$) is just equal to total economic cost ($ATC^* \times Q^*$). This result is similar to the long-run equilibrium solution for the perfectly competitive industry, where $P^* = ATC^*$ at the profit-maximizing output level. Unlike the perfectly competitive firm, where $P^* = MR$, profit-maximizing, monopolistically competitive firms produce at an output level at which $P^* > MR$, which is the same as that for monopolies.

The long-run competitive equilibrium for a monopolistically competitive industry can also be demonstrated as follows. By definition, total profit is defined as

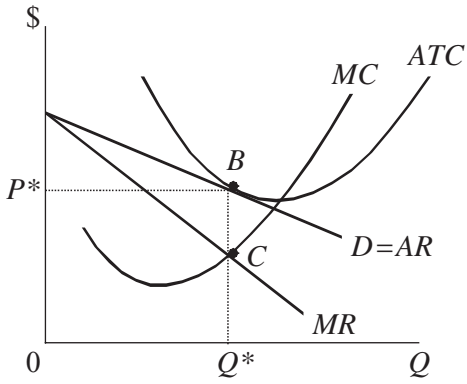

FIGURE 9.3 Long-run monopolistically competitive equilibrium and zero economic (normal) profit.

$$\pi = TR - TC = P^*Q^* - TC$$

Average profit is defined as

$$A\pi = \frac{\pi}{Q^*} = \frac{TR}{Q^*} - \frac{TC}{Q^*} = AR - ATC^*$$
$$= \frac{P^*Q^*}{Q^*} - ATC^*$$

Since $\pi = 0$, then $A\pi = 0$, then

$$P^* = ATC^*$$

This result is identical to the situation that arises in long-run perfectly competitive equilibrium.

The long-run monopolistically competitive equilibrium output level is to the left of the minimum point on its average total cost curve. Price equals average total cost, as in the case of long-run perfectly competitive equilibrium; however, price does not equal marginal revenue or marginal cost. Thus, output is lower and the price is higher than would be the case in a perfectly competitive industry. This result is similar to that found in the case of monopoly.

Problem 9.1. A typical firm in a monopolistically competitive industry faces the following demand and total cost equations for its product.

$$Q = 20 - \frac{P}{3}$$
$$TC = 100 - 5Q + Q^2$$

a. What is the firm's short-run, profit-maximizing price and output level?
b. What is the firm's economic profit?
c. Suppose that the existence of economic profit attracts new firms into the industry such that the new demand curve facing the typical firm in this

industry is $Q = 35/3 - P/3$. Assuming no change in the firm's total cost function, find the new profit-maximizing price and output level.

d. Is the firm earning an economic profit?

e. What, if anything, can you say about the relationship between the firm's demand and average cost curves? Is this result consistent with your answer to part c?

Solution

a. To maximize profit, the monopolistically competitive firm produces at the output level at which marginal cost equals marginal revenue. Price is determined along the demand curve. Solving the demand equation for price yields

$$P = 60 - 3Q$$

Substituting this result into the definition of total revenue yields

$$TR = PQ = (60 - 3Q)Q = 60Q - 3Q^2$$

Substituting this into the definition of total profit yields

$$\pi = TR - TC = 600Q - 3Q^2 - 100 + 5Q - Q^2 = -100 + 65Q - 4Q^2$$

Taking the first derivative of this expression with respect to Q and setting the resulting equation equal to zero yields

$$\frac{d\pi}{dQ} = 65 - 8Q = 0$$

The profit-maximizing output level is

$$Q^* = 8.125$$

Substituting this result into the demand equation results in

$$P^* = 60 - 3(8.125) = 35.625$$

b. The firm's economic profit is

$$\pi = -100 + 65(8.125) - 4(8.125)^2 = \$164.0625$$

These results are illustrated in the Figure 9.4.

c. The firm's new profit equation is

$$\pi = -100 + 40Q - 4Q^2$$

Taking the first derivative of this expression and setting the results equal to zero yields

$$\frac{d\pi}{dQ} = 40 - 8Q = 0$$

$$Q^* = 5$$

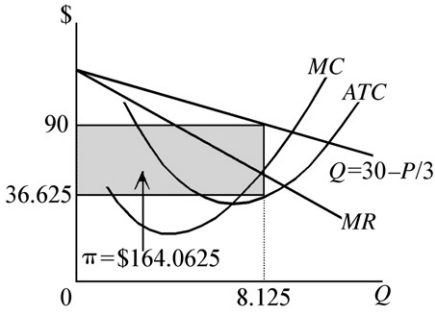

FIGURE 9.4 Diagrammatic solution to problem 9.1 part b.

Substituting this result into the demand equation yields

$$P^* = 35 - 3(35) = 20$$

d. The firm's economic profit is

$$\pi = -100 + 40(5) - 4(5)^2 = -100 + 200 - 100 = 0$$

This result is consistent with the profit-maximizing condition that marginal revenue must equal marginal cost, that is,

$$MR = MC$$

$$35 - 6Q = -5 + 2Q$$

$$Q^* = 5$$

e. The firm's average total cost equation is

$$ATC = \frac{TC}{Q} = \frac{100}{Q} - 5 + Q$$

The slope of this function is

$$\frac{dATC}{dQ} = \frac{-100}{Q^2} + 1$$

In long-run monopolistically competitive equilibrium, the slope of the *ATC* curve and the slope of the demand function are the same, therefore

$$\frac{-100}{Q^2} + 1 = -3$$

$$Q^* = 5$$

Moreover, at $Q^* = 5$, $ATC = 20 = P^*$. These results are consistent with the results in part c and are illustrated in Figure 9.5.

Problem 9.2. The demand equation for a product sold by a monopolistically competitive firm is

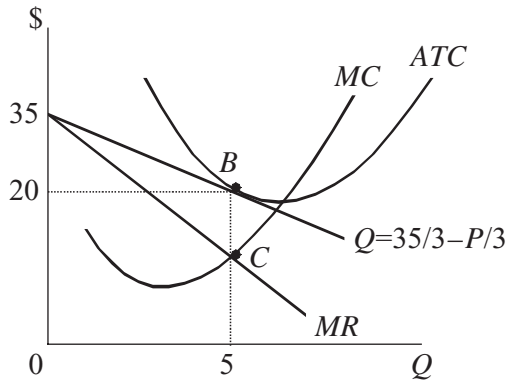

FIGURE 9.5 Diagrammatic solution to problem 9.1 part e.

$$Q_D = 25 - 0.5P$$

The total cost equation of the firm is

$$TC = 225 + 5Q + 0.25Q^2$$

a. Calculate the equilibrium price and quantity.
b. Is this firm in long-run or short-run equilibrium at the equilibrium price and quantity?
c. Diagram your answers to parts a and b.

Solution

a. The profit-maximizing condition is

$$MR = MC$$

The total revenue equation is

$$TR = PQ$$

Solving the demand equation for P yields

$$P = 50 - 2Q$$

Substituting this result into the total revenue equation yields

$$TR = (50 - 2Q)Q = 50Q - 2Q^2$$

The monopolist's marginal revenue equation is

$$MR = \frac{dTR}{dQ} = 50 - 4Q$$

The monopolist's marginal cost is

$$MC = \frac{dTC}{dQ} = 5 + 0.5Q$$

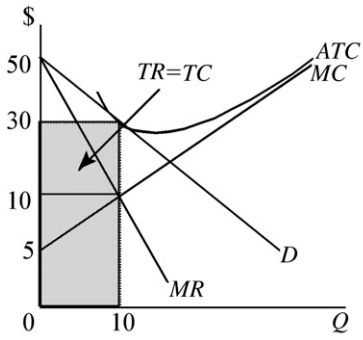

FIGURE 9.6 Diagrammatic solution to problem 9.2.

Substituting these results into the profit-maximizing condition yields the profit-maximizing output level:

$$50 - 4Q = 5 + 0.5Q$$

$$Q^* = 10$$

To determine the profit-maximizing (equilibrium) price, substitute this result into the demand equation:

$$P^* = 50 - 2(10) = \$30$$

b. Long-run competitive equilibrium is defined as the condition under which $\pi = 0$. In the short run, $\pi \neq 0$. The profit for the monopolistically competitive firm at $P^* = \$30$ and $Q^* = 10$ is

$$\pi = TR - TC = P^*Q^* - (225 + 5Q^* + 0.25Q^{*2})$$

$$= 30(10) - \left[225 + 5(10) + 0.25(10)^2\right] = 300 - 300 = \$0$$

We can conclude from this result that the monopolistically competitive firm is in long-run competitive equilibrium.

c. Figure 9.6 shows the answers to parts a and b.

Problem 9.3. The market equation for a product sold by a monopolistically competitive firm is

$$Q_D = 100 - 4P$$

The total cost equation of the firm is

$$TC = 500 + 10Q + 0.5Q^2$$

a. Calculate the equilibrium price and quantity.
b. Is this firm in long-run or short-run equilibrium at the equilibrium price and quantity?

Solution

a. The profit-maximizing condition is

$$MR = MC$$

The total revenue equation is

$$TR = PQ$$

Solving the demand equation for P yields

$$P = 25 - 0.25Q$$

Substituting this result into the total revenue equation yields

$$TR = (25 - 0.25Q)Q = 25Q - 0.25Q^2$$

The monopolist's marginal revenue equation is

$$MR = \frac{dTR}{dQ} = 25 - 0.5Q$$

The monopolist's marginal cost is

$$MC = \frac{dTC}{dQ} = 10 + Q$$

Substituting these results into the profit-maximizing condition yields the profit-maximizing output level:

$$25 - 0.5Q = 10 + Q$$

$$Q^* = 10$$

To determine the profit-maximizing (equilibrium) price, substitute this result into the demand equation:

$$P^* = 25 - 0.25(10) = \$22.5$$

b. Long-run competitive equilibrium is defined as the condition under which $\pi = 0$. In the short run, $\pi \neq 0$. The profit for the monopolistically competitive firm at $P^* = \$40$ and $Q^* = 20$ is

$$\pi = TR - TC = P^*Q^* - [500 + 10Q^* + 0.5Q^{*2}]$$
$$= 22.5(10) - [500 + 10(10) + 0.5(10^2)] = -\$425$$

Since $\pi < 0$, we can conclude from this result that the firm is in short-run monopolistically-competitive equilibrium.

ADVERTISING IN MONOPOLISTICALLY COMPETITIVE INDUSTRIES

The importance of advertising in monopolistic industries is readily apparent. Advertising highlights real or perceived product differences between and among products of firms in the industry. Advertising creates

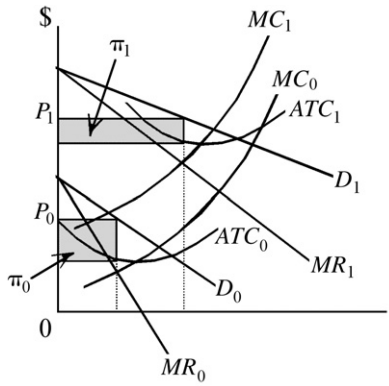

FIGURE 9.7 Successful advertising by a monopolistically competitive firm.

and reinforces customer loyalty, which gives the firm limited market power. The effect of successful advertising by firms in monopolistically competitive firms is illustrated in Figure 9.7.

In Figure 9.7 the demand curve for the firm's product shifts from D_0 to D_1 as a result of the firm's advertising expenditures. The costs of advertising are illustrated by the shifts in the marginal and average total cost curves from MC_0 to MC_1 and ATC_0 to ATC_1, respectively. These changes result in an increased unit sales and prices. In the situation depicted the Figure 9.7, the firm is clearly better off as a result of its presumably successful advertising campaign. This is seen by the increase in profits from π_0 to π_1.

How much advertising is optimal? In principle, the optimal level of advertising expenditure maximizes the firm's profits from having spent that money. As a general rule, the firm will maximize its profits from advertising by producing at an output level at which marginal production cost (including incremental advertising expenditures) equals marginal revenue.

EVALUATING MONOPOLISTIC COMPETITION

Many of the same criticisms of monopolistic market structures compared with perfect competition are applicable when one is evaluating monopolistic competition. As with monopoly, perfect competition may be considered to be a superior market structure because it results in greater output and lower prices than are obtained with monopolistic competition. This is because as with a monopolist, the demand curve confronting the monopolistically competitive firm is downward sloping. On the other hand, the demand curve confronting the monopolistically competitive firm is generally more elastic than that confronting the monopolist because of the existence of many close substitutes. Thus, the disparity between perfectly competitive and monopolistically competitive prices and output levels will

generally be less than what is found for the pricing and output decisions of the monopolist.

Another criticism of monopolistic competition in comparison to perfect competition is that production in the long run does not occur at minimum per-unit cost. Thus, monopolistically competitive firms are inherently less efficient than firms in perfectly competitive industries. On the other hand, as with perfect competition, relatively easy entry into and exit from the industry ensures that in the long-run monopolistically competitive firms earn zero economic profits. Moreover, unlike monopolies, entry and exit are relatively easy, which encourage product innovation and development.

Can we say anything good about monopolistic competition? Indeed, we can. Although production is less efficient, the consumer is rewarded with the greater product variety. In fact, it might be argued that the cost to the consumer of increased product variety is somewhat higher per-unit cost of production. This, of course, differs significantly from monopolies from which, in the long run, the consumer receives nothing in return for sluggish product innovation, production inefficiency, and higher per-unit costs.

At a more general level, the model of monopolistic competition has been the subject of numerous criticisms since it was first proposed by Chamberlin and Robinson in the early 1930s. To begin with, the existence of monopolistically competitive industries has been difficult to identify empirically. Product differentiation in industries comprising a large number of firms has been found to be minimal, which implies that the demand curves facing individual firms in the industry are approximately perfectly elastic (horizontal). Thus, the model of perfect competition has been found to provide a reasonably accurate approximation of the behavior of firms in monopolistically competitive industries.

It has also been found that industries characterized by products with strong brand-name recognition typically consist of a few large firms that dominate total industry output. As we will see in Chapter 10, these industries are best classified as oligopolistic. Finally, as with perfect competition, monopolistic competition assumes that the pricing and output decisions of one firm in the industry are unrelated to the pricing and output decisions of its competitors. This assumption has been found to be unrealistic, since a change in product price by one firm, say a local gasoline station, will prompt price changes by neighboring firms. Interdependency of pricing and output decisions of firms is characteristic of oligopolistic market structures.

CHAPTER REVIEW

Monopolistic competition is an example of an imperfect competition. Firms in such industries exercise a degree of market power, albeit less than that exercised by a monopoly. As in the cases of perfect competition and

monopoly, profit-maximizing monopolistically competitive and oligopolistic firms will produce at an output level at which $MR = MC$.

The characteristics of a monopolistically competitive industry are a large number of sellers acting independently, differentiated products, partial (and limited) control over product price, and relatively easy entry into and exit from the industry.

Product differentiation refers to real or perceived differences in goods or services produced by different firms in the same industry. Product differentiation permits market segmentation, which enables individual firms to set their own prices within limits. As in the case of a monopoly, each firm in a monopolistically competitive industry faces a downward-sloping demand curve, which implies that $P > MR$.

The short-run profit-maximizing condition for a monopolistically competitive firm is $P > MR = MC$. As in the case of perfect competition, the firm earns economic profit when $P > ATC$, which will attract new firms into the industry. As new firms enter the industry, existing firms lose market share. This is illustrated graphically by a shift to the left of each firm's demand curve. If $P < ATC$, the firm earns an economic loss, which will cause firms to exit the industry, resulting in an increase in market share and a shift to the right of the demand curve.

In the long run, the firm earns no economic profit because $P = ATC$. The demand curve for the firm's product is just tangent to the firm's average total cost curve. The long-run competitive equilibrium in monopolistically competitive industries is $P = ATC > MR = MC$. As in the case of monopoly, since $MC < ATC$, per-unit cost is not minimized; that is, monopolistically competitive firms produce inefficiently in the long run.

Advertising is an important element of monopolistic competition because it reinforces customer loyalty by highlighting real or perceived product differences between and among products of firms in the industry. The optimal level of advertising expenditures maximizes the firm's profits; profit maximization occurs when the firm is produced at an output level at which marginal cost (which includes incremental advertising expenditures) equals marginal revenue.

When compared with the model of perfect competition, in many respects monopolistic competition is considered to be an inferior market structure. As in the case of monopoly, the demand curve confronting a monopolistically competitive firm is downward sloping. Thus, monopolistic competition results in lower output levels and higher prices than are characteristic of perfect competition. Moreover, monopolistically competitive firms do not produce at minimum per-unit cost. On the other hand, although production is not as efficient as in perfect competition, the consumer is rewarded with the greater product variety. As in the case of perfect competition, relatively easy entry and exit encourage product innovation and development. In the long run, monopolistically competitive firms earn only a normal rate of return.

The model of monopolistic competition itself has been subjected to numerous criticisms. First, it has been empirically difficult to identify monopolistically competitive industries. Product differentiation in industries comprising a large number of firms has been found to be minimal. Industries characterized by strong brand-name recognition typically consist of a few large firms. Such industries are best described as oligopolistic. Finally, the assumption that the pricing and output decisions of one firm are unrelated to the pricing and output decisions of its competitors is unrealistic.

KEY TERMS AND CONCEPTS

Monopolistic competition The market structure in which there are many buyers and sellers of a differentiated good or service and it is relatively easy to enter and leave the industry.

P > MR = MC The selling price is greater than marginal revenue, which is equal to marginal cost, is the first-order profit-maximizing condition for a firm facing a downward-sloping demand curve for its good or service.

Product differentiation Exists when goods or services that are in fact somewhat different, or are so perceived by the consumer, nonetheless perform the same basic function.

CHAPTER QUESTIONS

9.1 Describe the similarities and differences between perfectly competitive and monopolistically competitive market structures.

9.2 In monopolistically competitive industries it is not important for each firm to supply products that are, in fact, different from those of competitors. It is important only that the public think that the products are different. Do you agree? Explain.

9.3 Monopolistically competitive firms are similar to monopolies in that they are able to earn economic profits in the long run. Do you agree with this statement? If not, then why not?

9.4 Monopolistically competitive firms are similar to monopolies in that they tend to charge a higher price and supply less product than firms in perfectly competitive industries. Do you agree? Explain.

9.5 In the long run, monopolistically competitive firms are inherently inefficient. Do you agree? Explain.

9.6 Explain the importance of advertising in monopolistically competitive industries. How does this compare with the importance of advertising in perfectly competitive industries?

9.7 In monopolistically competitive industries, what is the optimal level of advertising expenditure? Explain.

9.8 The demand for the product of a typical firm in a monopolistically competitive industry tends to be more price inelastic than the demand for the product of a monopolist. Do you agree? Explain.

9.9 In the long run, the selling price of a monopolistically competitive firm's product is equal to the minimum per-unit cost of production. Do you agree with this statement? If not, then why not?

9.10 If a typical firm in a monopolistically competitive industry earns an economic loss, should the firm shut down? Would your answer be different if the firm were perfectly competitive?

9.11 If some firms exit a monopolistically competitive industry, what will happen to the demand curve for the typical firm remaining in the industry?

9.12 Compared with perfect competition, how is monopolistic competition similar to monopoly? How different?

9.13 What are some of the criticisms of the model of monopolistic competition?

CHAPTER EXERCISES

9.1 Glamdring Enterprises produces a line of fine cutlery. The demand equation for the firm's top-of-the-line cutlery set, Orcrist, is

$$Q = 10 - 0.2P$$

Glamdring's total cost equation is

$$TC = 50 - 4Q + 2Q^2$$

a. Give the firm's short-run profit-maximizing price and output level. Verify that Glamdring is earning a positive economic profit. What is the relationship between price and average total cost?
b. Suppose that the existence of economic profits calculated in part a attracts new firms into the industry. As a result, the demand curve facing Glamdring becomes $Q = 4.38 - 0.095P$. Assuming no change in the firm's total cost function, give the new profit-maximizing price and output level.
c. Is this firm in long-run monopolistically competitive equilibrium?
d. What, if anything, can you say about the relation between the firm's demand and average cost curves? Is this result consistent with your answer to part c?

9.2 Suppose that a firm in a monopolistically competitive industry faces the following demand equation for its product:

$$Q = 9 - 0.1P$$

The firm's total cost equation is

$$TC = 75 - Q + 3Q^2$$

a. Give the firm's short-run profit-maximizing price and output.
b. Verify that the firm is earning a positive economic profit. What is the relationship between price and average total cost?
c. Suppose that the existence of positive economic profits attracts new firms into the industry. As a result, the new demand curve facing the firm is

$$Q = 3.891 - 0.04545P$$

Is this firm in long-run monopolistically competitive equilibrium?
d. What is the relationship between selling price and average total cost? Is this consistent with your answer to part c?

9.3 Suppose that in Exercise 9.2 the demand curve for the firm's product had been

$$Q = 3 - 0.04P$$

As before, the firm's total cost equation is

$$TC = 75 - Q + 3Q^2$$

a. Give the firm's short-run profit-maximizing price and output.
b. Verify that the firm is earning a negative economic profit. What is the relation between price and average total cost?
c. Suppose that the existence of negative economic profits causes some firms to exit the industry. As before, the demand curve facing the firm becomes

$$Q = 3.891 - 0.04545P$$

What is the relation between selling price and average total cost? Is this consistent with your answer to part b?

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