PART III
FIRM STRUCTURE

CHAPTER 10
MARKET POWER: MONOPOLY AND MONOPSONY

TEACHING NOTES

This chapter covers both monopoly and monopsony in order to highlight the similarity between the two types of market power. The chapter begins with a discussion of monopoly in sections 1-4. Section 5 first discusses monopsony, and then offers an instructive comparison of monopoly and monopsony. Section 6 discusses sources of monopsony power and the social costs of monopsony power, while section 7 concludes with a discussion of antitrust law. If you are pressed for time you might choose to only cover the first four sections on monopoly and skip the remainder of the chapter. Section 7 can be covered even if you choose to skip sections 5 and 6. The last part of section 1 on the multiplant firm can also be skipped if you are pressed for time.

Although chapter 8 presented the general rule for profit maximization, you should review marginal revenue and price elasticity of demand through a careful derivation of Equation 10.1. A discussion of the derivation of Equation 10.1 will elucidate the geometry of Figure 10.3. Point out that because marginal revenue is positive at the profit maximizing level of price and quantity for a monopolist, demand at that quantity is elastic. Equation 10.1 also leads directly to the Lerner Index in Section 10.2. This provides fruitful ground for a discussion of a monopolist's market power. For example, if E_d is large (e.g., because of close substitutes), then (1) the demand curve is relatively flat, (2) the marginal revenue curve is relatively flat (although steeper than the demand curve), and (3) the monopolist has little power to raise price above marginal cost. To reinforce these points, introduce a non-linear demand curve by, for example, showing the location of the marginal revenue curve for a unit-elastic demand curve. Once this concept has been clearly presented, the discussion of the effect of an excise tax on a monopolist with non-linear demand (Figure 10.5) will not seem out of place.

The social costs of market power are a good topic for class discussion, and this topic can be introduced by comparing the deadweight loss associated with monopoly with the analysis of market intervention given in Chapter 9. For example, compare Figure 10.10 with Figure 9.5. Given that Exercises (9), (13), and (15) involve "kinked marginal revenue curves," you should present Figure 10.11 if you plan to assign those problems. Although Figure 10.11 is complicated, exposure to it here will help when it reappears in Chapter 12.

REVIEW QUESTIONS

1. A monopolist is producing at a point at which marginal cost exceeds marginal revenue. How should it adjust its output to increase profit?

When marginal cost is greater than marginal revenue, the incremental cost of the last unit produced is greater than incremental revenue. The firm would increase its profit by not producing the last unit. It should continue to reduce production, thereby decreasing marginal cost and increasing marginal revenue, until marginal cost is equal to marginal revenue.

2. We write the percentage markup of prices over marginal cost as (P - MC)/P. For a profit-maximizing monopolist, how does this markup depend on the elasticity of demand? Why can this markup be viewed as a measure of monopoly power?

We can show that this measure of market power is equal to the negative inverse of the price elasticity of demand.

$$\frac{P - MC}{P} = -\frac{1}{E_D}$$

The equation implies that, as the elasticity increases (demand becomes more elastic), the inverse of elasticity decreases and the measure of market power decreases. Therefore, as elasticity increases (decreases), the firm has less (more) power to increase price above marginal cost.

3. Why is there no market supply curve under conditions of monopoly?

The monopolist's output decision depends not only on marginal cost, but also on the demand curve. Shifts in demand do not trace out a series of prices and quantities that we can identify as the supply curve for the firm. Instead, shifts in demand lead to changes in price, output, or both. Thus, there is no one-to-one correspondence between the price and the seller's quantity; therefore, a monopolized market lacks a supply curve.

4. Why might a firm have monopoly power even if it is not the only producer in the market?

The degree of monopoly power or market power enjoyed by a firm depends on the elasticity of the demand curve that it faces. As the elasticity of demand increases, i.e., as the demand curve becomes flatter, the inverse of the elasticity approaches zero and the monopoly power of the firm decreases. Thus, if the firm's demand curve has any elasticity less than infinity, the firm has some monopoly power.

5. What are some of the sources of monopoly power? Give an example of each.

The firm's exploitation of its monopoly power depends on how easy it is for other firms to enter the industry. There are several barriers to entry, including exclusive rights (e.g., patents, copyrights, and licenses) and economies of scale. These two barriers to entry are the most common. Exclusive rights are legally granted property rights to produce or distribute a good or service. Positive economies of scale lead to "natural monopolies" because the largest producer can charge a lower price, driving competition from the market. For example, in the production of aluminum, there is evidence to suggest that there are scale economies in the conversion of bauxite to alumina. (See *U.S. v. Aluminum Company of America*, 148 F.2d 416 [1945], discussed in Exercise 8, below.)

6. What factors determine the amount of monopoly power an individual firm is likely to have? Explain each one briefly.

Three factors determine the firm's elasticity of demand: (1) the elasticity of market demand, (2) the number of firms in the market, and (3) interaction among the firms in the market. The elasticity of market demand depends on the uniqueness of the product, i.e., how easy it is for consumers to substitute away from the product. As the number of firms in the market increases, the demand elasticity facing each firm increases because customers may shift to the firm's competitors. The number of firms in the market is determined by how easy it is to enter the industry (the height of barriers to entry). Finally, the ability to raise the price above marginal cost depends on how other firms react to the firm's price changes. If other firms match price changes, customers will have little incentive to switch to another supplier.

7. Why is there a social cost to monopoly power? If the gains to producers from monopoly power could be redistributed to consumers, would the social cost of monopoly power be eliminated? Explain briefly.

When the firm exploits its monopoly power to raise the price above marginal cost, consumers buy less at the higher price. Consumers enjoy less surplus, the difference between the price they are willing to pay and the market price on each unit consumed. Some of the lost consumer surplus is not captured by the seller and is a deadweight loss to society. Therefore, if the gains to producers were redistributed to consumers, society would still suffer the deadweight loss.

8. Why will a monopolist's output increase if the government forces it to lower its price? If the government wants to set a price ceiling that maximizes the monopolist's output, what price should it set?

By restricting price below the monopolist's profit-maximizing price, the government can change the shape of the firm's marginal revenue, *MR*, curve. When a price ceiling is imposed, *MR* is equal to the price ceiling for all quantities lower than the quantity demanded at the price ceiling. If the government wants to maximize output, it should set a price equal to marginal cost. Prices below this level induce the firm to decrease production, assuming the marginal cost curve is upward sloping. The regulator's problem is to determine the shape of the monopolist's marginal cost curve. This task is difficult given the monopolist's incentive to hide or distort this information.

9. How should a monopsonist decide how much of a product to buy? Will it buy more or less than a competitive buyer? Explain briefly.

The marginal expenditure is the change in the total expenditure as the purchased quantity changes. For a firm competing with many firms for inputs, the marginal expenditure is equal to the average expenditure (price). For a monopsonist, the marginal expenditure curve lies above the average expenditure curve because the decision to buy an extra unit raises the price that must be paid for all units, including the last unit. All firms should buy inputs so that the marginal value of the last unit is equal to the marginal expenditure on that unit. This is true for both the competitive buyer and the monopsonist. However, because the monopsonist's marginal expenditure curve lies above the average expenditure curve and because the marginal value curve is downward sloping, the monopsonist buys less than a firm would buy in a competitive market.

10. What is meant by the term "monopsony power"? Why might a firm have monopsony power even if it is not the only buyer in the market?

Monopsony power is the power in the factor market held by the buyer. A buyer facing an upward-sloping factor supply curve has some monopsony power. In a competitive market, the seller faces a perfectly-elastic market curve and the buyer faces a perfectly-elastic supply curve. Thus, any characteristic of the market (e.g., when there is a small number of buyers or if buyers engage in collusive behavior) that leads to a less-than-perfectly-elastic supply curve gives the buyer some monopsony power.

11. What are some sources of monopsony power? What determines the amount of monopsony power an individual firm is likely to have?

The individual firm's monopsony power depends on the characteristics of the "buying-side" of the market. There are three characteristics that enhance monopsony power: (1) the elasticity of market supply, (2) the number of buyers, and (3) how the buyers interact. The elasticity of market supply depends on how responsive producers are to changes in price. If, in the short run, supply is relatively fixed, then supply is relatively inelastic. For example, since tobacco farmers can sell their crop to only a handful of tobacco product producers, the power to buy at a price below marginal value is increased.

12. Why is there a social cost to monopsony power? If the gains to buyers from monopsony power could be redistributed to sellers, would the social cost of monopsony power be eliminated? Explain briefly.

With monopsony power, the price is lower and the quantity is less than under competitive buying conditions. Because of the lower price and reduced sales, sellers lose revenue. Only part of this lost revenue is transferred to the buyer as consumer surplus, and the net loss in total surplus is deadweight loss. Even if the consumer surplus could be redistributed to sellers, the deadweight loss persists. This inefficiency will remain because quantity is reduced below a level where price is equal to marginal cost.

13. How do the antitrust laws limit market power in the United States? Give examples of major provisions of the laws.

Antitrust laws, which are subject to interpretation by the courts, limit market power by proscribing a firm's behavior in attempting to maximize profit. Section 1 of the Sherman Act prohibits *every* restraint of trade, including any attempt to fix prices by buyers or sellers. Section 2 of the Sherman Act prohibits behavior that leads to monopolization. The Clayton Act, with the Robinson-Patman Act, prohibits price discrimination and exclusive dealing (sellers prohibiting buyers from buying goods from other sellers). The Clayton Act also limits mergers when they could substantially lessen competition. The Federal Trade Commission Act makes it illegal to use unfair or deceptive practices.

14. Explain briefly how the U.S. antitrust laws are actually enforced.

Antitrust laws are enforced in three ways: (1) through the Antitrust Division of the Justice Department, whenever firms violate federal statutes, (2) through the Federal Trade Commission, whenever firms violate the Federal Trade Commission Act, and (3) through civil suits. The Justice Department can seek to impose fines or jail terms on managers or owners involved or seek to reorganize the firm, as it did in its case against A.T.& T. The FTC can seek a voluntary understanding to comply with the law or a formal Commission order. Individuals or companies can sue in federal court for awards equal to three times the damage arising from the anti-competitive behavior.

EXERCISES

1. Will an increase in the demand for a monopolist's product always result in a higher price? Explain. Will an increase in the supply facing a monopsonist buyer always result in a lower price? Explain.

As illustrated in Figure 10.4b in the textbook, an increase in demand need not *always* result in a higher price. Under the conditions portrayed in Figure 10.4b, the monopolist supplies different quantities at the same price. Similarly, an increase in supply facing the monopsonist need not *always* result in a higher price. Suppose the average expenditure curve shifts from AE_1 to AE_2, as illustrated in Figure 10.1. With the shift in the average expenditure curve, the marginal expenditure curve shifts from ME_1 to ME_2. The ME_1 curve intersects the marginal value curve (demand curve) at Q_1, resulting in a price of P. When the AE curve shifts, the ME_2 curve intersects the marginal value curve at Q_2 resulting in the same price at P.

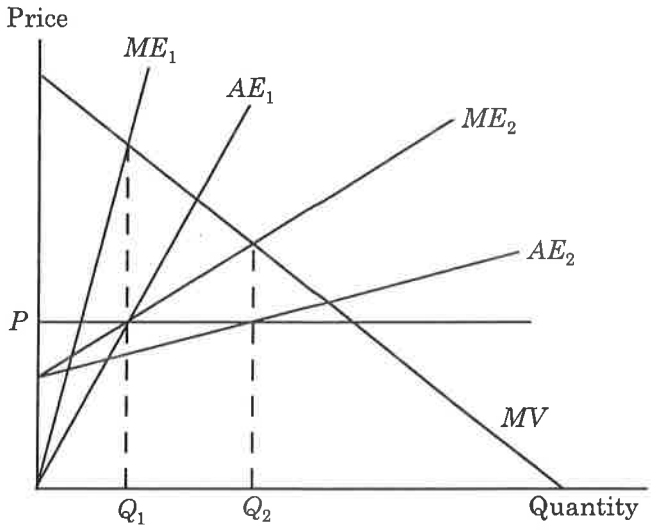

Figure 10.1

2. Caterpillar Tractor, one of the largest producers of farm machinery in the world, has hired you to advise them on pricing policy. One of the things the company would like to know is how much a 5 percent increase in price is likely to reduce sales. What would you need to know to help the company with this problem? Explain why these facts are important.

As a large producer of farm equipment, Caterpillar Tractor has market power and should consider the entire demand curve when choosing prices for its products. As their advisor, you should focus on the determination of the elasticity of demand for each product. There are three important factors to be considered. First, how similar are the products offered by Caterpillar's competitors? If they are close substitutes, a small increase in price could induce customers to switch to the competition. Secondly, what is the age of the existing stock of tractors? With an older population of tractors, a 5 percent price increase induces a smaller drop in demand. Finally, because farm tractors are a capital input in agricultural production, what is the expected profitability of the agricultural sector? If farm incomes are expected to fall, an increase in tractor prices induces a greater decline in demand than one would estimate with information on only past sales and prices.

3. A monopolist firm faces a demand with constant elasticity of -2.0. It has a constant marginal cost of $20 per unit and sets a price to maximize profit. If marginal cost should increase by 25 percent, would the price charged also rise by 25 percent?

Yes. The monopolist's pricing rule as a function of the elasticity of demand for its product is:

$$\frac{(P - MC)}{P} = -\frac{1}{E_d}$$

or alternatively,

$$P = \frac{MC}{\left(1 + \left(\frac{1}{E_d}\right)\right)}$$

In this example $E_d = -2.0$, so $1/E_d = -1/2$; price should then be set so that:

$$P = \frac{MC}{\left(\frac{1}{-2}\right)} = 2MC$$

Therefore, if MC rises by 25 percent price, then price will also rise by 25 percent. When MC = $20, P = $40. When MC rises to $20(1.25) = $25, the price rises to $50, a 25% increase.

4. A firm faces the following average revenue (demand) curve:

$$P = 100 - 0.01Q$$

where Q is weekly production and P is price, measured in cents per unit. The firm's cost function is given by C = 50Q + 30,000. Assuming the firm maximizes profits,

a. What is the level of production, price, and total profit per week?

The profit-maximizing output is found by setting marginal revenue equal to marginal cost. Given a linear demand curve in inverse form, $P = 100 - 0.01Q$, we know that the marginal revenue curve will have twice the slope of the demand curve. Thus, the marginal revenue curve for the firm is $MR = 100 - 0.02Q$. Marginal cost is simply the slope of the total cost curve. The slope of $TC = 30{,}000 + 50Q$ is 50. So MC equals 50. Setting $MR = MC$ to determine the profit-maximizing quantity:

$$100 - 0.02Q = 50, \text{ or}$$

$$Q = 2{,}500.$$

Substituting the profit-maximizing quantity into the inverse demand function to determine the price:

$$P = 100 - (0.01)(2{,}500) = 75 \text{ cents.}$$

Profit equals total revenue minus total cost:

$$\pi = (75)(2{,}500) - (30{,}000 + (50)(2{,}500)), \text{ or}$$

$$\pi = \$325 \text{ per week.}$$

b. If the government decides to levy a tax of 10 cents per unit on this product, what will be the new level of production, price, and profit?

Suppose initially that the consumers must pay the tax to the government. Since the total price (including the tax) consumers would be willing to pay remains unchanged, we know that the demand function is

$$P^* + T = 100 - 0.01Q, \text{ or}$$
$$P^* = 100 - 0.01Q - T,$$

where P^* is the price received by the suppliers. Because the tax increases the price of each unit, total revenue for the monopolist decreases by TQ, and marginal revenue, the revenue on each additional unit, decreases by T:

$$MR = 100 - 0.02Q - T$$

where $T = 10$ cents. To determine the profit-maximizing level of output with the tax, equate marginal revenue with marginal cost:

$$100 - 0.02Q - 10 = 50, \text{ or}$$

$$Q = 2{,}000 \text{ units.}$$

Substituting Q into the demand function to determine price:

$$P^* = 100 - (0.01)(2{,}000) - 10 = 70 \text{ cents.}$$

Profit is total revenue minus total cost:

$$\pi = (70)(2{,}000) - ((50)(2{,}000) + 30{,}000) = 10{,}000 \text{ cents, or}$$

$$\$100 \text{ per week.}$$

Note: The price facing the consumer after the imposition of the tax is 80 cents. The monopolist receives 70 cents. Therefore, the consumer and the monopolist each pay 5 cents of the tax.

If the monopolist had to pay the tax instead of the consumer, we would arrive at the same result. The monopolist's cost function would then be

$$TC = 50Q + 30{,}000 + TQ = (50 + T)Q + 30{,}000.$$

The slope of the cost function is $(50 + T)$, so $MC = 50 + T$. We set this MC to the marginal revenue function from part (a):

$$100 - 0.02Q = 50 + 10, \text{ or}$$

$$Q = 2{,}000.$$

Thus, it does not matter who sends the tax payment to the government. The burden of the tax is reflected in the price of the good.

5. The following table shows the demand curve facing a monopolist who produces at a constant marginal cost of $10.

Price	Quantity
27	0
24	2
21	4
18	6
15	8
12	10
9	12
6	14
3	16
0	18

a. Calculate the firm's marginal revenue curve.

To find the marginal revenue curve, we first derive the inverse demand curve. The intercept of the inverse demand curve on the price axis is 27. The slope of the inverse demand curve is the change in price divided by the change in quantity. For example, a decrease in price from 27 to 24 yields an increase in quantity from 0 to 2. Therefore, the slope is $-\frac{3}{2}$, and the demand curve is

$$P = 27 - 1.5Q.$$

The marginal revenue curve corresponding to a linear demand curve is a line with the same intercept as the inverse demand curve and a slope that is twice as steep. Therefore, the marginal revenue curve is

$$MR = 27 - 3Q.$$

b. What are the firm's profit-maximizing output and price? What is its profit?

The monopolist's maximizing output occurs where marginal revenue equals marginal cost. Marginal cost is a constant \$10. Setting MR equal to MC to determine the profit-maximizing quantity:

$$27 - 3Q = 10, \text{ or } Q = 5.67.$$

To find the profit-maximizing price, substitute this quantity into the demand equation:

$$P = 27 - (1.5)(5.67) = \$18.5.$$

Total revenue is price times quantity:

$$TR = (18.5)(5.67) = \$104.83.$$

The profit of the firm is total revenue minus total cost, and total cost is equal to average cost times the level of output produced. Since marginal cost is constant, average variable cost is equal to marginal cost. Ignoring any fixed costs, total cost is $10Q$ or 56.67, and profit is

$$104.83 - 56.67 = \$48.17.$$

c. What would the equilibrium price and quantity be in a competitive industry?

For a competitive industry, price would equal marginal cost at equilibrium. Setting the expression for price equal to a marginal cost of 10:

$$27 - 1.5Q = 10 \Rightarrow Q = 11.3 \Rightarrow P = 10.$$

Note the increase in the equilibrium quantity compared to the monopoly solution.

d. What would the social gain be if this monopolist were forced to produce and price at the competitive equilibrium? Who would gain and lose as a result?

The social gain arises from the elimination of deadweight loss. Deadweight loss in this case is equal to the triangle above the constant marginal cost curve, below the demand curve, and between the quantities 5.67 and 11.3, or numerically

$$(18.5\text{-}10)(11.3\text{-}5.67)(.5)=\$24.10.$$

Consumers gain this deadweight loss plus the monopolist's profit of $48.17. The monopolist's profits are reduced to zero, and the consumer surplus increases by $72.27.

6. A firm has two factories for which costs are given by:

$$\text{Factory \# 1: } C_1(Q_1) = 10Q_1^2$$

$$\text{Factory \# 2: } C_2(Q_2) = 20Q_2^2$$

The firm faces the following demand curve:

$$\mathbf{P = 700 - 5Q}$$

where Q is total output, i.e. $Q = Q_1 + Q_2$.

a. On a diagram, draw the marginal cost curves for the two factories, the average and marginal revenue curves, and the total marginal cost curve (i.e., the marginal cost of producing $Q = Q_1 + Q_2$). Indicate the profit-maximizing output for each factory, total output, and price.

The average revenue curve is the demand curve,

$$P = 700 - 5Q.$$

For a linear demand curve, the marginal revenue curve has the same intercept as the demand curve and a slope that is twice as steep:

$$MR = 700 - 10Q.$$

Next, determine the marginal cost of producing Q. To find the marginal cost of production in Factory 1, take the first derivative of the cost function with respect to Q:

$$\frac{dC_1(Q_1)}{dQ} = 20Q_1.$$

Similarly, the marginal cost in Factory 2 is

$$\frac{dC_2(Q_2)}{dQ} = 40Q_2.$$

Rearranging the marginal cost equations in inverse form and horizontally summing them, we obtain total marginal cost, MC_T:

$$Q = Q_1 + Q_2 = \frac{MC_1}{20} + \frac{MC_2}{40} = \frac{3MC_T}{40}, \text{ or}$$

$$MC_T = \frac{40Q}{3}.$$

Profit maximization occurs where $MC_T = MR$. See Figure 10.6.a for the profit-maximizing output for each factory, total output, and price.

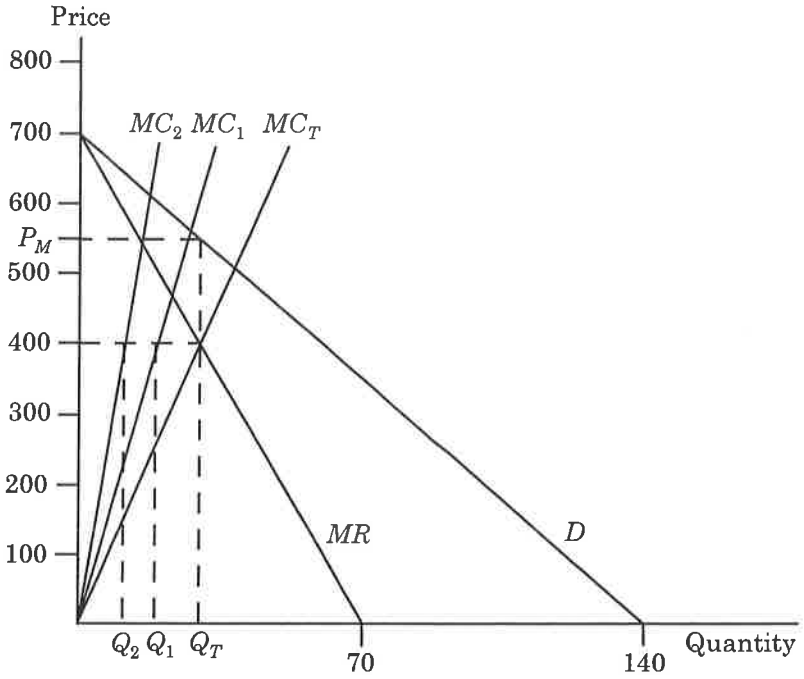

Figure 10.6.a

b. Calculate the values of Q_1, Q_2, Q, and P that maximize profit.

Calculate the total output that maximizes profit, i.e., Q such that $MC_T = MR$:

$$\frac{40Q}{3} = 700 - 10Q, \text{ or } Q = 30.$$

Next, observe the relationship between MC and MR for multiplant monopolies:

$$MR = MC_T = MC_1 = MC_2.$$

We know that at $Q = 30$, $MR = 700 - (10)(30) = 400$.

Therefore,

$$MC_1 = 400 = 20Q_1, \text{ or } Q_1 = 20 \text{ and}$$

$$MC_2 = 400 = 40Q_2, \text{ or } Q_2 = 10.$$

To find the monopoly price, P_M, substitute for Q in the demand equation:

$$P_M = 700 - (5)(30), \text{ or}$$

$$P_M = 550.$$

c. Suppose labor costs increase in Factory 1 but not in Factory 2. How should the firm adjust the following(i.e., raise, lower, or leave unchanged): Output in Factory 1? Output in Factory 2? Total output? Price?

An increase in labor costs will lead to a horizontal shift to the left in MC_1, causing MC_T to shift to the left as well (since it is the horizontal sum of MC_1 and MC_2). The new MC_T curve intersects the MR curve at a lower quantity and higher marginal revenue. At a higher level of marginal revenue, Q_2 is greater than at the original level for MR. Since Q_T falls and Q_2 rises, Q_1 must fall. Since Q_T falls, price must rise.

7. A drug company has a monopoly on a new patented medicine. The product can be made in either of two plants. The costs of production for the two plants are

$MC_1 = 20 + 2Q_1$, and $MC_2 = 10 + 5Q_2$. The firm's estimate of the demand for the product is

$P = 20 - 3(Q_1 + Q_2)$. How much should the firm plan to produce in each plant, and at what price should it plan to sell the product?

First, notice that *only* MC_2 is relevant because the marginal cost curve of the first plant lies above the demand curve.

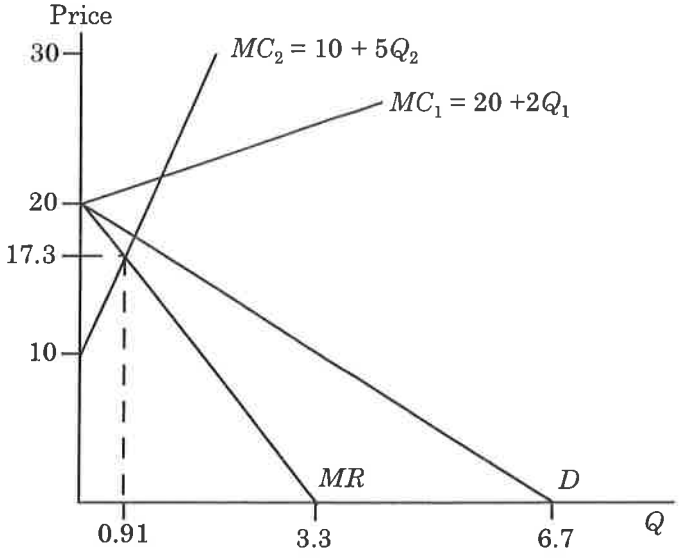

Figure 10.7

This means that the demand curve becomes $P = 20 - 3Q_2$. With an inverse linear demand curve, we know that the marginal revenue curve has the same vertical intercept but twice the slope, or $MR = 20 - 6Q_2$. To determine the profit-maximizing level of output, equate MR and MC_2:

$$20 - 6Q_2 = 10 + 5Q_2, \text{ or}$$

$$Q = Q_2 = 0.91.$$

Price is determined by substituting the profit-maximizing quantity into the demand equation:

$$P = 20 - 3(0.91) = 17.3.$$

8. One of the more important antitrust cases of this century involved the Aluminum Company of America (Alcoa) in 1945. At that time, Alcoa controlled about 90 percent of primary aluminum production in the United States, and the company had been accused of monopolizing the aluminum market. In its defense, Alcoa argued that although it indeed controlled a large fraction of the primary market, secondary aluminum (i.e., aluminum produced from the recycling of scrap) accounted for roughly 30 percent of the total supply of aluminum, and many competitive firms were engaged in recycling. Therefore, Alcoa argued, it did not have much monopoly power.

a. Provide a clear argument *in favor* of Alcoa's position.

Although Alcoa controlled about 90 percent of primary aluminum production in the United States, secondary aluminum production by recyclers accounted for 30 percent of the total aluminum supply. Therefore, with a higher price, a much larger proportion of aluminum supply could come from secondary sources. This assertion is true because there is a large stock of potential supply in the economy. Therefore, the price elasticity

of demand for Alcoa's primary aluminum is much higher (in absolute value) than we would expect, given Alcoa's dominant position in primary aluminum production. In many applications, other metals such as copper and steel are feasible substitutes for aluminum. Again, the demand elasticity Alcoa faces might be higher than we would otherwise expect.

b. Provide a clear argument *against* Alcoa's position.

While Alcoa could not raise its price by very much at any one time, the stock of potential aluminum supply is limited. Therefore, by keeping a stable high price, Alcoa could reap monopoly profits. Also, since Alcoa had originally produced the metal reappearing as recycled scrap, it would have considered the effect of scrap reclamation on future prices. Therefore, it exerted effective monopolistic control over the secondary metal supply.

c. The 1945 decision by Judge Learned Hand has been called "one of the most celebrated judicial opinions of our time." Do you know what Judge Hand's ruling was?

Judge Hand ruled against Alcoa but did not order it to divest itself of any of its United States production facilities. The two remedies imposed by the court were (1) that Alcoa was barred from bidding for two primary aluminum plants constructed by the government during World War II (they were sold to Reynolds and Kaiser) and (2) that it divest itself of its Canadian subsidiary, which became Alcan.

9. A monopolist faces the demand curve P = 11 - Q, where P is measured in dollars per unit and Q in thousands of units. The monopolist has a constant average cost of $6 per unit.

a. Draw the average and marginal revenue curves and the average and marginal cost curves. What are the monopolist's profit-maximizing price and quantity? What is the resulting profit? Calculate the firm's degree of monopoly power using the Lerner index.

Because demand (average revenue) may be described as $P = 11 - Q$, we know that the marginal revenue function is $MR = 11 - 2Q$. We also know that if average cost is constant, then marginal cost is constant and equal to average cost: $MC = 6$.

To find the profit-maximizing level of output, set marginal revenue equal to marginal cost:

$$11 - 2Q = 6, \text{ or } Q = 2.5.$$

That is, the profit-maximizing quantity equals 2,500 units. Substitute the profit-maximizing quantity into the demand equation to determine the price:

$$P = 11 - 2.5 = \$8.50.$$

Profits are equal to total revenue minus total cost,

$$\pi = TR - TC = (AR)(Q) - (AC)(Q), \text{ or}$$

$$\pi = (8.5)(2.5) - (6)(2.5) = 6.25, \text{ or } \$6{,}250.$$

The degree of monopoly power is given by the Lerner Index:

$$\frac{P - MC}{P} = \frac{8.5 - 6}{8.5} = 0.294.$$

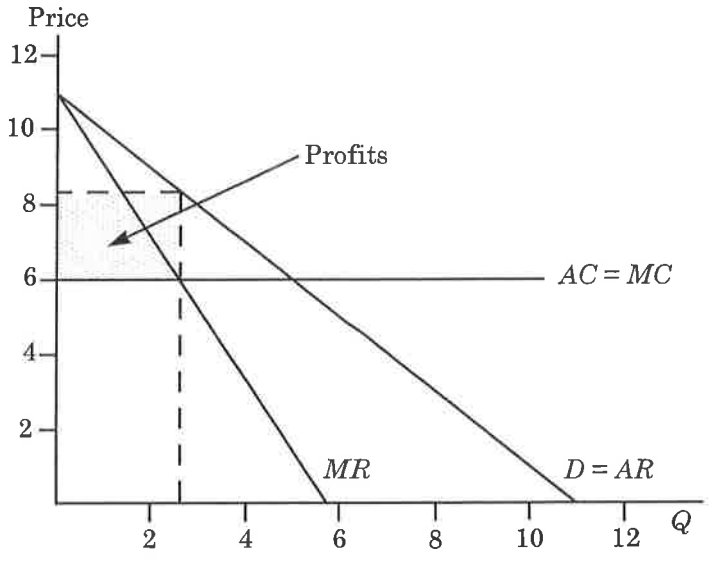

Figure 10.9.a

b. A government regulatory agency sets a price ceiling of $7 per unit. What quantity will be produced, and what will the firm's profit be? What happens to the degree of monopoly power?

To determine the effect of the price ceiling on the quantity produced, substitute the ceiling price into the demand equation.

$$7 = 11 - Q, \text{ or}$$

$$Q = 4{,}000.$$

The monopolist will pick the price of $7 because it is the highest price that it can charge, and this price is still greater than the constant marginal cost of $6, resulting in positive monopoly profit.

Profits are equal to total revenue minus total cost:

$$\pi = (7)(4{,}000) - (6)(4{,}000) = \$4{,}000.$$

The degree of monopoly power is:

$$\frac{P - MC}{P} = \frac{7 - 6}{7} = 0.143.$$

c. What price ceiling yields the largest level of output? What is that level of output? What is the firm's degree of monopoly power at this price?

If the regulatory authority sets a price below $6, the monopolist would prefer to go out of business instead of produce because it cannot cover its average costs. At any price above $6, the monopolist would produce less than the 5,000 units that would be produced in a competitive industry. Therefore, the regulatory agency should set a price ceiling of $6, thus making the monopolist face a horizontal effective demand curve up to Q = 5,000. To ensure a positive output (so that the monopolist is not indifferent between producing 5,000 units and shutting down), the price ceiling should be set at $6 + δ, where δ is small.

Thus, 5,000 is the maximum output that the regulatory agency can extract from the monopolist by using a price ceiling. The degree of monopoly power is

$$\frac{P - MC}{P} = \frac{6 + \delta - 6}{6} = \frac{\delta}{6} \to 0 \text{ as } \delta \to 0.$$

10. Michelle's Monopoly Mutant Turtles (MMMT) has the exclusive right to sell Mutant Turtle t-shirts in the United States. The demand for these t-shirts is $Q = 10{,}000/P^2$. The firm's short-run cost is SRTC = 2,000 + 5Q, and its long-run cost is LRTC = 6Q.

a. What price should MMMT charge to maximize profit in the short run? What quantity does it sell, and how much profit does it make? Would it be better off shutting down in the short run?

MMMT should offer enough t-shirts such that *MR* = *MC*. In the short run, marginal cost is the change in *SRTC* as the result of the production of another t-shirt, i.e., *SRMC* = 5, the slope of the *SRTC* curve. Demand is:

$$Q = \frac{10{,}000}{P^2},$$

or, in inverse form,

$$P = 100Q^{-1/2}.$$

Total revenue (*PQ*) is $100Q^{1/2}$. Taking the derivative of *TR* with respect to *Q*, $MR = 50Q^{-1/2}$. Equating *MR* and *MC* to determine the profit-maximizing quantity:

$$5 = 50Q^{-1/2}, \text{ or } Q = 100.$$

Substituting $Q = 100$ into the demand function to determine price:

$$P = (100)(100^{-1/2}) = 10.$$

The profit at this price and quantity is equal to total revenue minus total cost:

$$\pi = (10)(100) - (2000 + (5)(100)) = -\$1{,}500.$$

Although profit is negative, price is above the average variable cost of 5 and therefore, the firm should not shut down in the short run. Since most of the firm's costs are fixed, the firm loses $2,000 if nothing is produced. If the profit-maximizing quantity is produced, the firm loses only $1,500.

b. What price should MMMT charge in the long run? What quantity does it sell and how much profit does it make? Would it be better off shutting down in the long run?

In the long run, marginal cost is equal to the slope of the *LRTC* curve, which is 6.

Equating marginal revenue and long run marginal cost to determine the profit-maximizing quantity:

$$50Q^{-1/2} = 6 \text{ or } Q = 69.44$$

Substituting $Q = 69.44$ into the demand equation to determine price:

$$P = (100)[(50/6)^2]^{-1/2} = (100)(6/50) = 12$$

Therefore, total revenue is $833.33 and total cost is $416.67. Profit is $416.67. The firm should remain in business.

c. Can we expect MMMT to have lower marginal cost in the short run than in the long run? Explain why.

In the long run, MMMT must replace all fixed factors. Therefore, we can expect *LRMC* to be higher than *SRMC*.

11. You produce widgets to sell in a perfectly competitive market at a market price of $10 per widget. Your widgets are manufactured in two plants, one in Massachusetts and the other in Connecticut. Because of labor problems in Connecticut, you are forced to raise wages there, so marginal costs in that plant increase. In response to this, should you shift production and produce more in the Massachusetts plant?

No, production should not shift to the Massachusetts plant, although production in the Connecticut plant should be reduced. In order to maximize profits, a multiplant

firm will schedule production at all plants so that the following two conditions are met:

- Marginal costs of production at each plant are equal.

- Marginal revenue of the total amount produced is equal to the marginal cost at each plant.

These two rules can be summarized as $MR=MC_1=MC_2= MC_T$, where the subscript indicates the plant.

The firm in this example has two plants and is in a perfectly competitive market. In a perfectly competitive market P = MR. To maximize profits, production among the plants should be allocated such that:

$$P = MC_c(Q_c) = MC_m(Q_m),$$

where the subscripts denote plant locations (c for Connecticut, etc.). The marginal costs of production have increased in Connecticut but have not changed in Massachusetts. Since costs have not changed in Massachusetts, the level of Q_m that sets $MC_m(Q_m) = P$, has not changed.

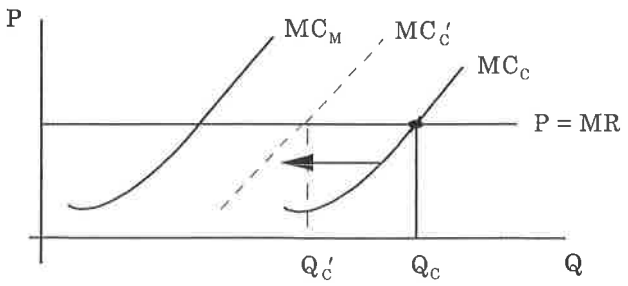

Figure 10.11

12. The employment of teaching assistants (TAs) by major universities can be characterized as a monopsony. Suppose the demand for TAs is W = 30,000 - 125n, where W is the wage (as an annual salary), and n is the number of TAs hired. The supply of TAs is given by W = 1,000 + 75n.

a. If the university takes advantage of its monopsonist position, how many TAs will it hire? What wage will it pay?

The supply curve is equivalent to the average expenditure curve. With a supply curve of $W = 1{,}000 + 75n$, the total expenditure is $Wn = 1{,}000n + 75n^2$. Taking the derivative of the total expenditure function with respect to the number of TAs, the marginal expenditure curve is $1{,}000 + 150n$. As a monopsonist, the university would equate marginal value (demand) with marginal expenditure to determine the number of TAs to hire:

$$30{,}000 - 125n = 1{,}000 + 150n, \text{ or}$$

$$n = 105.5.$$

Substituting $n = 105.5$ into the supply curve to determine the wage:

$$1{,}000 + (75)(105.5) = \$8{,}909 \text{ annually.}$$