*Unit 4*

BBM 102/05

Microeconomics

# Market Structure and Market Power

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# Unit Overview

Unit 3 focused on the behaviour of firms under a perfect competition. A perfect competition, however, is merely one of the many possible ways to organise a market.

Unit 4 focuses on other common ways to organise a market. First, we will provide you with a general introduction to market structure, and then we will study the theory of monopoly in some detail. Monopolies are bad because of their restriction on output which results in high prices. Why are there monopolies? Are they inevitable? How does a monopolist decide its behaviour? Can a government regulate monopolies so as to improve market outcomes? These are the questions that need to be answered.

Next, we will briefly discuss the theory of monopolistic competition. These firms have a combination of characteristics that are evident in both perfect competition and monopoly. Monopolistic firms produce goods that are differentiated. This allows these firms to portray a certain level of monopoly power in different market segments. .

Lastly, we will spend some time on the theory of oligopoly. To study oligopolies, we need to employ a new branch of mathematics "game theory". (We will only study the simpler aspects of game theory.) Then, we will analyse oligopoly equilibrium and the behaviour of cartels.

# Unit Objectives

By the end of Unit 4, you should be able to:

1. Explain the theories of monopoly, oligopoly and monopolistic competition.
2. Compare different theories of market structure.
3. Apply different theories of market structure to explain real world market phenomena.
4. Provide public policy recommendations on various market structures and the meaning of competition.

# 4.1 Monopoly

## Objectives

By the end of this section, you should be able to:

1. Define monopoly and the relationship between price setting and monopoly power.

2. List and explain the sources of monopoly power and how they can change over time.

3. Define what is meant by a natural monopoly.

## Introduction

Monopoly is at the opposite end of the spectrum of market models from perfect competition. A monopoly firm has no rivals. It is the only firm in its industry. There are no close substitutes for the good or service a monopoly produces. Not only does a monopoly firm have the market to itself, but it also need not worry about other firms entering. In the case of monopoly, entry by potential rivals is prohibitively difficult.

A monopoly does not take the market price as given; it determines its own price. It selects from its demand curve the price that corresponds to the quantity the firm has chosen to produce in order to earn the maximum profit possible. The entry of new firms, which eliminates profit in the long run in a competitive market, cannot occur in the monopoly model.

A firm that sets or picks price based on its output decision is called a price setter. A firm that acts as a price setter possesses monopoly power. We shall see in the next chapter that monopolies are not the only firms that have this power; however, the absence of rivals in monopoly gives it much more price-setting power.

As was the case when we discussed perfect competition in the previous chapter, the assumptions of the monopoly model are rather strong. In assuming there is one firm in a market, we assume there are no other firms producing goods or services that could be considered part of the same market as that of the monopoly firm. In assuming blocked entry, we assume, for reasons we will discuss below, that no other firm can enter that market. Such conditions are rare in the real world. As always with models, we make the assumptions that define monopoly in order to simplify our analysis, not to describe the real world. The result is a model that gives us important insights into the nature of the choices of firms and their impact on the economy.

## Sources of monopoly power

Why are some markets dominated by single firms? What are the sources of monopoly power? Economists have identified a number of conditions that, individually or in combination, can lead to domination of a market by a single firm and create barriers that prevent the entry of new firms.

Barriers to entry are characteristics of a particular market that block new firms from entering it. They include economies of scale, special advantages of location, high sunk costs, a dominant position in the ownership of some of the inputs required to produce the good, and government restrictions. These barriers may be interrelated, making entry much more formidable. Although these barriers might allow one firm to gain and hold monopoly control over a market, there are often other factors that can erode this control. At this level, we will not look at these factors.

### Economies of scale

Scale economies and diseconomies define the shape of a firm's long-run average cost (*LRAC*) curve as it increases its output. If long-run average cost declines as the level of production increases, a firm is said to experience *economies of scale*.

A firm that confronts economies of scale over the entire range of outputs demanded in its industry is a natural monopoly. Utilities that distribute electricity, water, and natural gas to some markets are examples. In a natural monopoly, the *LRAC* of any one firm intersects the market demand curve where long-run average costs are falling or are at a minimum. If this is the case, one firm in the industry will expand to exploit the economies of scale available to it. Because this firm will have lower unit cost than its rivals, it can drive them out of the market and gain monopoly control over the industry.

Suppose there are 12 firms, each operating at the scale shown by *ATC*1 (average total cost) in **Figure 4.1**. A firm that expanded its scale of operation to achieve an average total cost curve such as *ATC*2 could produce 240 units of output at a lower cost than could the smaller firms producing 20 units each. By cutting its price below the minimum average total cost of the smaller plants, the larger firm could drive the smaller ones out of business. In this situation, the industry demand is not large enough to support more than one firm. If another firm attempted to enter the industry, the natural monopolist would always be able to undersell it.

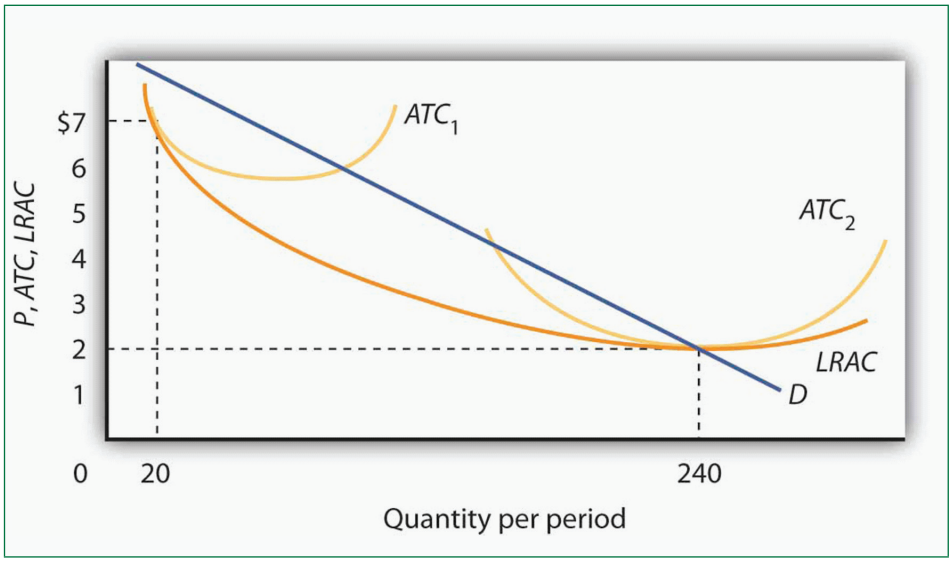



**Figure 4.1** Economies of scale lead to natural monopoly

## Location

Sometimes monopoly power is the result of location. For example, sellers in markets isolated by distance from their nearest rivals have a degree of monopoly power. The local movie theatre in a small town has a monopoly in showing first-run movies. Doctors, dentists, and mechanics in isolated towns may also be monopolists.

Usually small towns or villages contain firms which demonstrate monopoly-like characteristics. For example, being the sole grocery in a village would make the owner a monopolist. Villagers would have no choice but to buy from this grocery. Although the villagers can look for alternatives, this usually means travelling to the nearest town increasing household expenditure.

## Sunk costs

The greater the cost of establishing a new business in an industry, the more difficult it is to enter that industry. That cost will, in turn, be greater if the outlays required to start a business are unlikely to be recovered if the business should fail.

Suppose, for example, that entry into a particular industry requires extensive advertising to make consumers aware of the new brand. Should the effort fail, there is no way to recover the expenditures for such advertising. An expenditure that has already been made and that cannot be recovered is called a sunk cost.

If a substantial fraction of a firm's initial outlays will be lost upon exit from the industry, exit will be costly. Difficulty of exit can make for difficulty of entry. The more firms have to lose from an unsuccessful effort to penetrate a particular market, the less likely they are to try. The potential for high sunk costs could thus contribute to the monopoly power of an established firm by making entry by other firms more difficult.

## Restricted ownership of raw materials and inputs

In very few cases the source of monopoly power is the ownership of strategic inputs. If a particular firm owns all of an input required for the production of a particular good or service, then it could emerge as the only producer of that good or service.

The Aluminum Company of America (ALCOA) gained monopoly power through its ownership of virtually all the bauxite mines in the world (bauxite is the source of aluminum). The International Nickel Company of Canada at one time owned virtually all the world's nickel. De Beers acquired rights to nearly all the world's diamond production, giving it enormous power in the market for diamonds. With new diamond supplies in Canada, Australia, and Russia being developed and sold independently of DeBeers, however, this power has declined, and today DeBeers controls a substantially smaller percentage of the world's supply.

Provisions under the Petroleum Development Act 1974 give PETRONAS the exclusive rights in oil exploration in Malaysia. This allows this petroleum giant to maintain a monopoly status in Malaysia for the last three decades.

## Government restrictions

Another important basis for monopoly power consists of special privileges granted to some business firms by government agencies. State and local governments have commonly assigned exclusive franchises — rights to conduct business in a specific market — to taxi and bus companies, to cable television companies, and to providers of telephone services, electricity, natural gas, and water, although the trend in recent years has been to encourage competition for many of these services. Governments might also regulate entry into an industry or a profession through licensing and certification requirements. For example, to be an accountant in Malaysia, one's qualification must be accepted by the Malaysian Institute of Accountants (MIA). Governments also provide patent protection to inventors of new products or production methods in order to encourage innovation; these patents may afford their holders a degree of monopoly power during the 20-year life of the patent.

Patents can take on extra importance when network effects are present. Network effects arise in situations where products become more useful the larger the number of users of the product. For example, one advantage of using the Windows computer operating system is that so many other people use it. That has advantages in terms of sharing files and other information.

## Summary

An industry with a single firm, in which entry is blocked, is called a monopoly. A firm that sets or picks price depending on its output decision is called a price setter. A price setter possesses monopoly power. The sources of monopoly power include economies of scale, locational advantages, high sunk costs associated with entry, restricted ownership of key inputs, and government restrictions, such as exclusive franchises, licensing and certification requirements, and patents. A firm that confronts economies of scale over the entire range of output demanded in an industry is a natural monopoly.

## Self-test 4.1

What is the source of monopoly power — if any — in each of the following situations?

1. The Ministry of Health granted Burroughs exclusive rights until 2013 to manufacture and distribute AZT, a drug used in the treatment of AIDS.

2. Ali and Abu run the only shoe repair shop in town.

3. One utility company distributes residential electricity in your town.

4. The widespread use of automatic teller machines (ATMs) has proven a boon to Diebold, the principal manufacturer of the machines.

# 4.2 The Monopoly Model

## Objectives

By the end of this section, you should be able to:

1. Explain the relationship between price and marginal revenue when a firm faces a downward-sloping demand curve.

2. Explain the relationship between marginal revenue and elasticity along a linear demand curve.

3. Apply the marginal decision rule to explain how a monopoly maximises profit.

## Introduction

Analysing choices is a more complex challenge for a monopoly firm than for a perfectly competitive firm. After all, a competitive firm takes the market price as given and determines its profit-maximising output. Because a monopoly has its market all to itself, it can determine not only its output but its price as well. What kinds of price and output choices will such a firm make?

We will answer that question in the context of the marginal decision rule: a firm will produce additional units of a good until marginal revenue equals marginal cost. To apply that rule to a monopoly firm, we must first investigate the special relationship between demand and marginal revenue for a monopoly.

## Monopoly and market demand

Because a monopoly firm has its market all to itself, it faces the market demand curve. **Figure 4.2** compares the demand situations faced by a monopoly and a perfectly competitive firm. In Panel (a), the equilibrium price for a perfectly competitive firm is determined by the intersection of the demand and supply curves. The market supply curve is found simply by summing the supply curves of individual firms. Those, in turn, consist of the portions of marginal cost curves that lie above the average variable cost curves. The marginal cost curve, MC, for a single firm is illustrated. Notice the break in the horizontal axis indicating that the quantity produced by a single firm is a trivially small fraction of the whole. In the perfectly competitive model, one firm has nothing to do with the determination of the market price. Each firm in a perfectly competitive industry faces a horizontal demand curve defined by the market price.

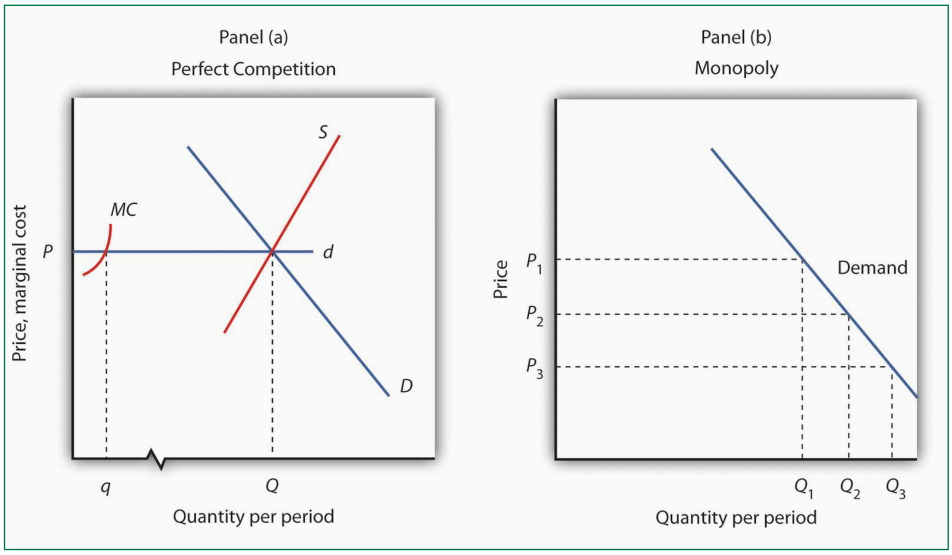



**Figure 4.2** Perfect competition versus monopoly

*Panel (a) shows the determination of equilibrium price and output in a perfectly competitive market. A typical firm with marginal cost curve MC is a price taker, choosing to produce quantity q at the equilibrium price P. In Panel (b) a monopoly faces a downward-sloping market demand curve. As a profit maximiser, it determines its profit-maximising output. Once it determines that quantity, however, the price at which it can sell that output is found from the demand curve. The monopoly firm can sell additional units only by lowering price. The perfectly competitive firm, by contrast, can sell any quantity it wants at the market price.*

Contrast the situation shown in Panel (a) with the one faced by the monopoly firm in Panel (b). Because it is the only supplier in the industry, the monopolist faces the downward-sloping market demand curve alone. It may choose to produce any quantity. But, unlike the perfectly competitive firm, which can sell all it wants at the going market price, a monopolist can sell a greater quantity only by cutting its price.

Suppose, for example, that a monopoly firm can sell quantity *Q*1 units at a price *P*1 in Panel (b). If it wants to increase its output to *Q*2 units — and sell that quantity — it must reduce its price to *P*2. To sell quantity *Q*3 it would have to reduce the price to *P*3. The monopoly firm may choose its price and output, but it is restricted to a combination of price and output that lies on the demand curve. It could not, for example, charge priceP1 and sell quantity *Q*3. To be a price setter, a firm must face a downward-sloping demand curve.

## Total revenue and price elasticity

A firm's elasticity of demand with respect to price has important implications for assessing the impact of a price change on total revenue. Also, the price elasticity of demand can be different at different points on a firm's demand curve. In this section, we shall see why a monopoly firm will always select a price in the elastic region of its demand curve.

Suppose the demand curve facing a monopoly firm is given by Equation 4.1, where Q is the quantity demanded per unit of time and P is the price per unit:

*Equation 4.1*

$$Q = 10 - P$$

This demand equation implies the demand schedule shown in **Figure 4.3**. Total revenue for each quantity equals the quantity times the price at which that quantity is demanded. The monopoly firm's total revenue curve is given in Panel (b). Because a monopolist must cut the price of every unit in order to increase sales, total revenue does not always increase as output rises. In this case, total revenue reaches a maximum of RM25 when 5 units are sold. Beyond 5 units, total revenue begins to decline.

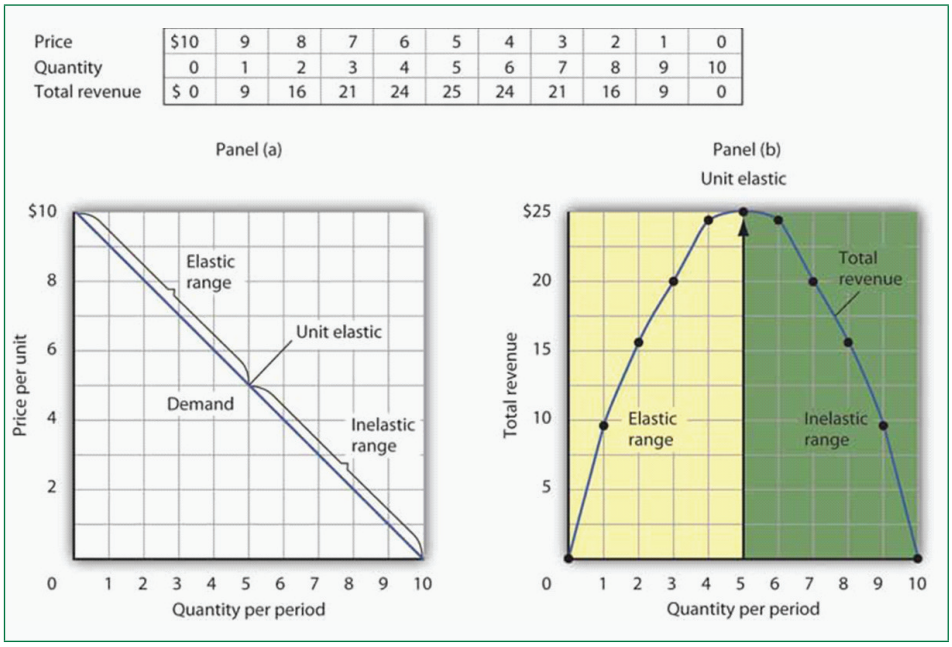



**Figure 4.3** Demand, elasticity and total revenue

*Suppose a monopolist faces the downward-sloping demand curve shown in Panel (a). In order to increase the quantity sold, it must cut the price. Total revenue is found by multiplying the price and quantity sold at each price. Total revenue, plotted in Panel (b), is maximised at RM25, when the quantity sold is 5 units and the price is RM5. At that point on the demand curve, the price elasticity of demand equals –1 (please refer to Unit 2 on how this elasticity coefficient is derived).*

The demand curve in Panel (a) of **Figure 4.3** shows ranges of values of the price elasticity of demand. We have learnt that price elasticity varies along a linear demand curve in a special way: Demand is price elastic at points in the upper half of the demand curve and price inelastic in the lower half of the demand curve. If demand is price elastic, a price reduction increases total revenue. To sell an additional unit, a monopoly firm must lower its price.

The sale of one more unit will increase revenue because the percentage increase in the quantity demanded exceeds the percentage decrease in the price. The elastic range of the demand curve corresponds to the range over which the total revenue curve is rising in Panel (b) of **Figure 4.3**.

If demand is price inelastic, a price reduction reduces total revenue because the percentage increase in the quantity demanded is less than the percentage decrease in the price. Total revenue falls as the firm sells additional units over the inelastic range of the demand curve. The downward-sloping portion of the total revenue curve in Panel (b) corresponds to the inelastic range of the demand curve.

Finally, recall that the midpoint of a linear demand curve is the point at which demand becomes unit price elastic. That point on the total revenue curve in Panel (b) corresponds to the point at which total revenue reaches a maximum.

The relationship among price elasticity, demand, and total revenue has an important implication for the selection of the profit-maximising price and output: A monopoly firm will never choose a price and output in the inelastic range of the demand curve. Suppose, for example, that the monopoly firm represented in **Figure 4.3** is charging RM3 and selling 7 units. Its total revenue is thus RM21. Because this combination is in the inelastic portion of the demand curve, the firm could increase its total revenue by raising its price. It could, at the same time, reduce its total cost. Raising price means reducing output; a reduction in output would reduce total cost. If the firm is operating in the inelastic range of its demand curve, then it is not maximising profits. The firm could earn a higher profit by raising price and reducing output. It will continue to raise its price until it is in the elastic portion of its demand curve. A profit-maximising monopoly firm will therefore select a price and output combination in the elastic range of its demand curve.

Of course, the firm could choose a point at which demand is unit price elastic. At that point, total revenue is maximised. But the firm seeks to maximise profit, not total revenue. A solution that maximises total revenue will not maximise profit unless marginal cost is zero.

## Demand and marginal revenue

In the perfectly competitive case, the additional revenue a firm gains from selling an additional unit — its marginal revenue — is equal to the market price. The firm's demand curve, which is a horizontal line at the market price, is also its marginal revenue curve. But a monopoly firm can sell an additional unit only by lowering the price. That fact complicates the relationship between the monopoly's demand curve and its marginal revenue.

Suppose the firm in **Figure 4.3** sells 2 units at a price of RM8 per unit. Its total revenue is RM16. Now it wants to sell a third unit and wants to know the marginal revenue of that unit. To sell 3 units rather than 2, the firm must lower its price to RM7 per unit. Total revenue rises to RM21. The marginal revenue of the third unit is thus RM5. But the price at which the firm sells 3 units is RM7. Marginal revenue is less than price.

To see why the marginal revenue of the third unit is less than its price, we need to examine more carefully how the sale of that unit affects the firm's revenues. The firm brings in RM7 from the sale of the third unit.

But selling the third unit required the firm to charge a price of RM7 instead of the RM8 the firm was charging for 2 units. Now the firm receives less for the first 2 units. The marginal revenue of the third unit is the RM7 the firm receives for that unit minus the RM1 reduction in revenue for each of the first two units. The marginal revenue of the third unit is thus RM5. (In this chapter we assume that the monopoly firm sells all units of output at the same price. In the next chapter, we will look at cases in which firms charge different prices to different customers.)

Marginal revenue is less than price for the monopoly firm. **Figure 4.4** shows the relationship between demand and marginal revenue, based on the demand curve introduced in **Figure 4.3**. As always, we follow the convention of plotting marginal values at the midpoints of the intervals.

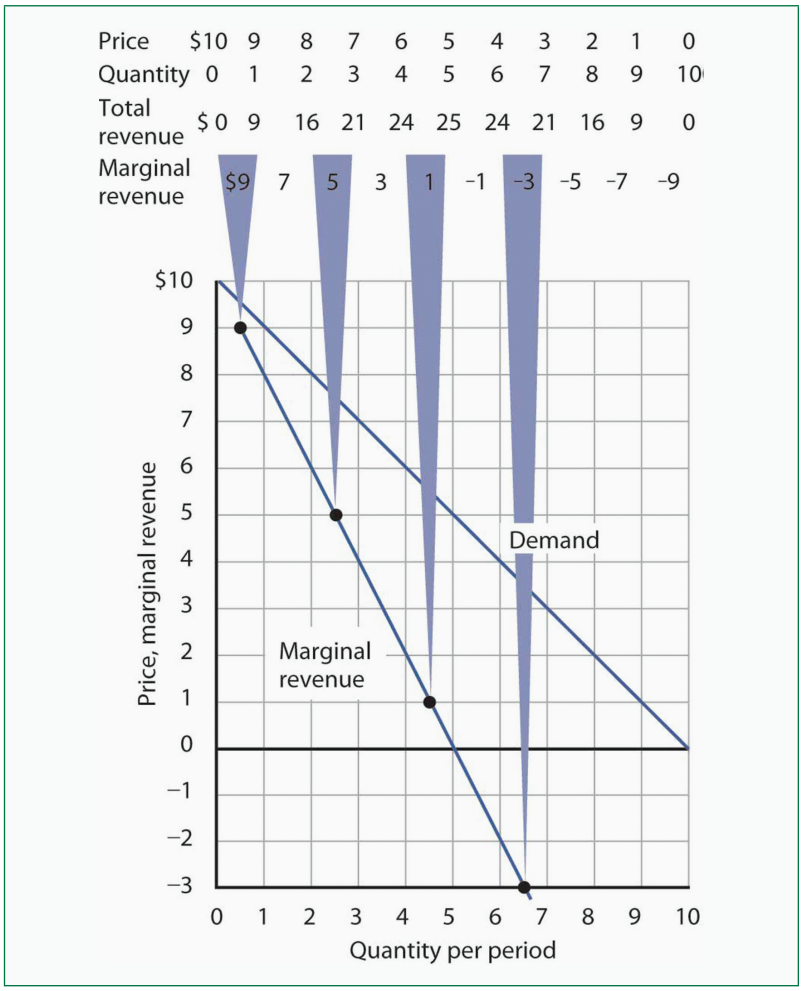



**Figure 4.4** Demand and marginal revenue

The marginal revenue curve for the monopoly firm lies below its demand curve. It shows the additional revenue gained from selling an additional unit. Notice that, as always, marginal values are plotted at the midpoints of the respective intervals.

When the demand curve is linear, as in **Figure 4.4**, the marginal revenue curve can be placed according to the following rules: the marginal revenue curve is always below the demand curve and the marginal revenue curve will bisect any horizontal line drawn between the vertical axis and the demand curve. To put it another way, the marginal revenue curve will be twice as steep as the demand curve. The demand curve in **Figure 4.4** is given by the equation $Q = 10 - P$, which can be written $P = 10 - Q$. The marginal revenue curve is given by $P = 10 - 2Q$, which is twice as steep as the demand curve. This can be observed looking at the slope value in both equations.

The marginal revenue and demand curves in **Figure 4.4** follow these rules. The marginal revenue curve lies below the demand curve, and it bisects any horizontal line drawn from the vertical axis to the demand curve. At a price of RM6, for example, the quantity demanded is 4. The marginal revenue curve passes through 2 units at this price. At a price of 0, the quantity demanded is 10; the marginal revenue curve passes through 5 units at this point.

Just as there is a relationship between the firm's demand curve and the price elasticity of demand, there is a relationship between its marginal revenue curve and elasticity. Where marginal revenue is positive, demand is price elastic. Where marginal revenue is negative, demand is price inelastic. Where marginal revenue is zero, demand is unit price elastic.

A firm would not produce an additional unit of output with negative marginal revenue. And, assuming that the production of an additional unit has some cost, a firm would not produce the extra unit if it has zero marginal revenue. Because a monopoly firm will generally operate where marginal revenue is positive, we see once again that it will operate in the elastic range of its demand curve.

## Monopoly equilibrium: Applying the marginal decision rule

Profit-maximising behaviour is always based on the marginal decision rule: Additional units of a good should be produced as long as the marginal revenue of an additional unit exceeds the marginal cost. The maximising solution occurs where marginal revenue equals marginal cost. As always, firms seek to maximise economic profit, and costs are measured in the economic sense of opportunity cost. **Figure 4.5** shows a demand curve and an associated marginal revenue curve facing a monopoly firm. The marginal cost curve is like those we derived earlier; it falls over the range of output in which the firm experiences increasing marginal returns, then rises as the firm experiences diminishing marginal returns.

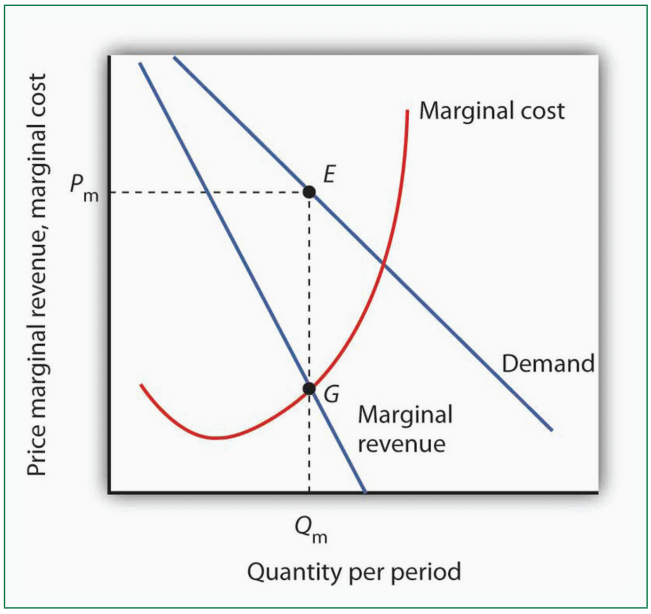



**Figure 4.5** The monopoly solution

*The monopoly firm maximises profit by producing an output Qm at point G, where the marginal revenue and marginal cost curves intersect. It sells this output at price Pm.*

To determine the profit-maximising output, we note the quantity at which the firm's marginal revenue and marginal cost curves intersect (Qm in **Figure 4.5**). We read up from Qm to the demand curve to find the price Pm at which the firm can sell Qm units per period. The profit maximising price and output are given by point E on the demand curve.

Thus we can determine a monopoly firm's profit-maximising price and output by following three steps:

1. Determine the demand, marginal revenue, and marginal cost curves.

2. Select the output level at which the marginal revenue and marginal cost curves intersect.

3. Determine from the demand curve the price at which that output can be sold.

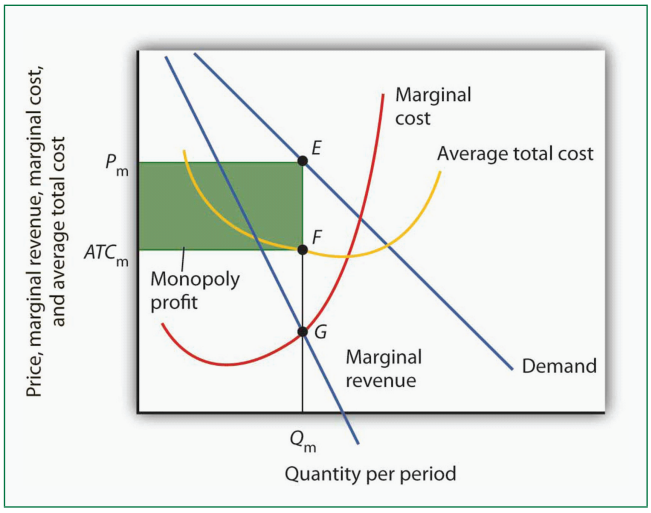



**Figure 4.6** Computing monopoly profit

*A monopoly firm's profit per unit is the difference between price and average total cost. Total profit equals profit per unit times the quantity produced. Total profit is given by the area of the shaded rectangle ATCmPmEF.*

Once we have determined the monopoly firm's price and output, we can determine its economic profit by adding the firm's average total cost curve to the graph showing demand, marginal revenue, and marginal cost, as shown in **Figure 4.6**. The average total cost (*ATC*) at an output of *Q*m units is *ATC*m. The firm's profit per unit is thus Pm – *ATC*m. Total profit is found by multiplying the firm's output, *Q*m, by profit per unit, so total profit equals *Q*m(Pm – *ATC*m)—the area of the shaded rectangle in **Figure 4.6**.

## Summary

If a firm faces a downward-sloping demand curve, marginal revenue is less than price. Marginal revenue is positive in the elastic range of a demand curve, negative in the inelastic range, and zero where demand is unit price elastic. If a monopoly firm faces a linear demand curve, its marginal revenue curve is also linear, lies below the demand curve, and bisects any horizontal line drawn from the vertical axis to the demand curve. To maximise profit or minimise losses, a monopoly firm produces the quantity at which marginal cost equals marginal revenue. Its price is given by the point on the demand curve that corresponds to this quantity.

## Self-test 4.2

The Troll Road Company is considering building a toll road. It estimates that its linear demand curve is as shown below. Assume that the fixed cost of the road is RM0.5 million per year. Maintenance costs, which are the only other costs of the road, are also given in the table.

| Tolls per trip | RM1.00 | RM0.90 | RM0.80 | RM0.70 | RM0.60 | RM0.50 |
|---|---|---|---|---|---|---|
| Number of trips per year (million) | 1 | 2 | 3 | 4 | 5 | 6 |
| Mainte-nance cost per year (million) | RM0.7 | RM1.2 | RM1.8 | RM2.9 | RM4.2 | RM6.0 |

1. Using the midpoint convention, compute the profit-maximising level of output.

2. Using the midpoint convention, what price will the company charge?

3. What is marginal revenue at the profit-maximising output level? How does marginal revenue compare to price?

# 4.3 Assessing Monopoly

## Objectives

By the end of this section, you should be able to:

1. Explain and illustrate that a monopoly firm produces an output that is less than the efficient level and why this results in a deadweight loss to society.

2. Explain and illustrate how the higher price that a monopoly charges, compared to an otherwise identical perfectly competitive firm, transfers part of consumer surplus to the monopolist and raises questions of equity.

3. Discuss the potential effects that a monopoly may have on consumer choices, price, quality of products, and technological innovations.

4. Discuss the public policy responses to monopoly.

## Introduction

We have seen that for monopolies pursuing profit maximisation, the outcome differs from the case of perfect competition. Does this matter to society? In this section, we will focus on the differences that stem from market structure and assess their implications.

## Efficiency, equity and concentration of power

A monopoly firm determines its output by setting marginal cost equal to marginal revenue. It then charges the price at which it can sell that output, a price determined by the demand curve. That price exceeds marginal revenue; it therefore exceeds marginal cost as well. That contrasts with the case in perfect competition, in which price and marginal cost are equal. The higher price charged by a monopoly firm may allow it a profit — in large part at the expense of consumers, whose reduced options may give them little say in the matter. The monopoly solution thus raises problems of efficiency, equity, and the concentration of power.

### Monopoly and efficiency

The fact that price in monopoly exceeds marginal cost suggests that the monopoly solution violates the basic condition for economic efficiency, that the price system must confront decision makers with all of the costs and all of the benefits of their choices. Efficiency requires that consumers confront prices that equal marginal costs. Because a monopoly firm charges a price greater than marginal cost, consumers will consume less of the monopoly's good or service than is economically efficient.

To contrast the efficiency of the perfectly competitive outcome with the inefficiency of the monopoly outcome, imagine a perfectly competitive industry whose solution is depicted in F**igure 4.7**. The short-run industry supply curve is the summation of individual marginal cost curves; it may be regarded as the marginal cost curve for the industry. A perfectly competitive industry achieves equilibrium at point C, at price Pc and quantity *Q*c.

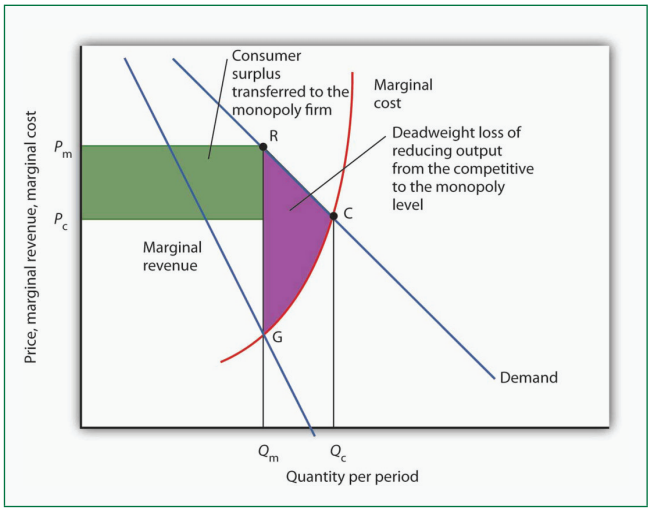



**Figure 4.7** Perfect competition, monopoly and efficiency

*Given market demand and marginal revenue, we can compare the behaviour of a monopoly to that of a perfectly competitive industry. The marginal cost curve may be thought of as the supply curve of a perfectly competitive industry. The perfectly competitive industry produces quantity Qc and sells the output at price Pc. The monopolist restricts output to Qm and raises the price to Pm. Reorganising a perfectly competitive industry as a monopoly results in a deadweight loss to society given by the shaded area GRC. It also transfers a portion of the consumer surplus earned in the competitive case to the monopoly firm.*

Now, suppose that all the firms in the industry merge and a government restriction prohibits entry by any new firms. Our perfectly competitive industry is now a monopoly. Assume the monopoly continues to have the same marginal cost and demand curves that the competitive industry did. The monopoly firm faces the same market demand curve, from which it derives its marginal revenue curve. It maximises profit at output *Q*m and charges price *P*m. Output is lower and price higher than in the competitive solution.

Society would gain by moving from the monopoly solution at *Q*m to the competitive solution at *Q*c. The benefit to consumers would be given by the area under the demand curve between *Q*m and *Q*c; it is the area *Q*mRC*Q*c. An increase in output, of course, has a cost. Because the marginal cost curve measures the cost of each additional unit, we can think of the area under the marginal cost curve over some range of output as measuring the total cost of that output. Thus, the total cost of increasing output from *Q*m to *Q*c is the area under the marginal cost curve over that range — the area *Q*mGC*Q*c. Subtracting this cost from the benefit gives us the

net gain of moving from the monopoly to the competitive solution; it is the shaded area GRC. That is the potential gain from moving to the efficient solution. The area GRC is a deadweight loss.

## Monopoly and equity

The monopoly solution raises issues not just of efficiency but also of equity. **Figure 4.7** shows that the monopolist charges price Pm rather than the competitive price Pc; the higher price charged by the monopoly firm reduces consumer surplus. Consumer surplus is the difference between what consumers are willing to pay for a good and what they actually pay. It is measured by the area under the demand curve and above the price of the good over the range of output produced.

If the industry were competitive, consumer surplus would be the area below the demand curve and above *P*cC. With monopoly, consumer surplus would be the area below the demand curve and above PmR. Part of the reduction in consumer surplus is the area under the demand curve between *Q*c and *Q*m; it is contained in the deadweight loss area GRC. But consumers also lose the area of the rectangle bounded by the competitive and monopoly prices and by the monopoly output; this lost consumer surplus is transferred to the monopolist.

The fact that society suffers a deadweight loss due to monopoly is an efficiency problem. But the transfer of a portion of consumer surplus to the monopolist is an equity issue. Is such a transfer legitimate? After all, the monopoly firm enjoys a privileged position, protected by barriers to entry from competition. Should it be allowed to extract these gains from consumers? We will see that public policy suggests that the answer is no. Regulatory efforts imposed in monopoly cases often seek to reduce the degree to which monopoly firms extract consumer surplus from consumers by reducing the prices these firms charge.

## Monopoly and the concentration of power

The objections to monopoly run much deeper than worries over economic efficiency and high prices. Because it enjoys barriers that block potential rivals, a monopoly firm wields considerable market power. For many people, that concentration of power is objectionable. A decentralised, competitive market constantly tests the ability of firms to satisfy consumers, pushes them to find new products and new and better production methods, and whittles away economic profits. Firms that operate in the shelter of monopoly may be largely immune to such pressures. Consumers are likely to be left with fewer choices, higher costs, and lower quality.

Perhaps more important in the view of many economists is the fact that the existence of economic profits provides both an incentive and the means for monopolists to aggressively protect their position and extend it if possible. These economists point out that monopolists may be willing to spend their economic profits in attempts to influence political leaders and public authorities (including regulatory authorities) who can help them maintain or enhance their monopoly position.

Graft and corruption may be the result, claim these critics. Indeed, Microsoft has been accused by its rivals of bullying computer manufacturers into installing its web browser, Internet Explorer, exclusively on their computers. Attitudes about Microsoft reflect these concerns. Even among people who feel that its products are good and fairly priced, there is uneasiness about our seeming dependence on them. And once it has secured its dominant position, will it charge more for its products? Will it continue to innovate?

## Monopoly and price discrimination

Because there are people willing to pay more than the marginal cost, it seems as if the monopolist in our earlier example is leaving some money on the table. Is there a way for the monopolist to make higher profits? The answer to this question hinges on an assumption that was implicit in our analysis: we suppose that the monopolist has to sell every unit of the good at the same price. In many cases, however, firms sell different units of their product at different prices. This is known as price discrimination, and it can arise either because (1) a firm sells to different customers at different prices or because (2) a firm sells different units at different prices to the same customer. There are numerous examples of both kinds of price discrimination. An example of the first is discounts offered to senior citizens or students. An example of the second is quantity discounts such as "buy two, get one free."

Firms have developed many creative forms of price discrimination, and we could easily fill a whole chapter with them. Our main focus here, however, is to understand how price discrimination operates in a monopoly market. Let us think about a case where the monopolist faces a unit demand curve: each buyer either purchases a unit of the good or does not buy the good at all. The downward-sloping demand curve comes from the fact that different individuals have different valuations of the good.

Now imagine what the monopolist would do if she knew everyone's individual valuations and was also able to charge a different price to different buyers. In this case, we obtain a remarkable result. If the monopolist could sell each unit at any price she wanted, then she would charge each individual his valuation of the good, with striking consequences.

1. The monopolist captures the entire buyer surplus. Compared to the competitive case, there is a redistribution of surplus from buyers to the monopolist.

2. The deadweight loss from the monopoly is eliminated. The monopolist produces the same level of output as in a competitive market because it is worthwhile to sell to anyone whose valuation exceeds marginal cost.

Buyers obtain no surplus because each buyer surplus equals his valuation minus the price he pays — which we have just said is equal to his valuation. Each buyer is actually indifferent about buying or not buying the good. (If this seems odd, then you can imagine that the monopolist charges a price slightly below individuals' valuations, so buyers obtain only a tiny amount of surplus. The conclusion is the same.) So where does their surplus go? It shows up as monopoly profits. By price discriminating, the monopolist captures all the gains from trade in this market. And where do these monopoly profits eventually go? They flow to the owners of the monopoly. The buyer surplus that is taken away by the price-discriminating monopolist is eventually returned to the household sector as dividends from the firm. However, it is not the same households who gain and lose surplus. Not everyone is a shareholder in the monopoly. Monopoly power causes a redistribution from the monopolists' customers to its shareholders.

A situation like the one we have described, where a monopolist knows the valuations of all her customers, may seem a bit farfetched. Still, in situations where a monopolist negotiates individual prices with buyers, she will do her best to guess their valuations. For example, think of a used car dealer. When a prospective customer arrives on the lot, the dealer will typically engage the customer in conversation in an attempt to learn where he lives, what kind of job he has, and so on. Such information helps the dealer guess the buyer's valuation.

There are many kinds of price discrimination.

1. **Explicit segmentation.** The monopolist may be able to divide the market into identifiable segments and charge different prices to different segments. For example, movie theatres often offer student and senior citizen discounts. As another example, businesses often charge different prices in different countries. The idea is that the monopolist can charge higher prices to segments that are less price sensitive.

2. **Self-selection.** If a firm cannot explicitly identify different segments, it can set a menu of prices and allow customers to sort themselves into different groups. When Apple introduced the iPhone, it originally charged a high price, knowing that impatient customers would buy immediately. It then dropped the price to capture the more patient, more price-sensitive customers. Discount coupons are another example. Individuals with more time to spare will clip and redeem coupons — and these individuals will typically also be more sensitive to price.

From the perspective of a firm, the biggest danger of price discrimination is the possibility of arbitrage. If you are selling your product more cheaply to some than to others, you don't want someone to buy at the cheap price and then resell to your higher-value customers. This is a particular issue for pharmaceutical companies that charge different prices in different countries. If you need proof of this, look at the spam in your e-mail. The chances are very good that you have recently received an e-mail offering you pharmaceuticals at Canadian prices.

## Public policy toward monopoly

Pulling together what we have learnt in this unit on monopoly and previously on perfect competition, **Table 4.1** summarises the differences between the models of perfect competition and monopoly. Most importantly we note that whereas the perfectly competitive firm is a price taker, the monopoly firm is a price setter. Because of this difference, we can object to monopoly on grounds of economic efficiency; monopolies produce too little and charge too much. Also, the high price and persistent profits strike many as inequitable. Others may simply see monopoly as an unacceptable concentration of power.

| Characteristic or Event | Perfect competition | Monopoly |
|---|---|---|
| Market | Large number of sellers and buyers producing a homogeneous good or service, easy entry. | Large number of buyers, one seller. Entry is blocked. |
| Demand and marginal revenue curves | The firm's demand and marginal revenue curve is a horizontal line at the market price. | The firm faces the market demand curve; marginal revenue is below market demand. |
| Price | Determined by demand and supply; each firm is a price taker. Price equals marginal cost. | The monopoly firm determines price; it is a price setter. Price is greater than marginal cost. |
| Profit maximisation | Firms produce where marginal cost equals marginal revenue. | Firms produce where marginal cost equals marginal revenue and charge the corresponding price on the demand curve. |
| Profit | Entry forces economic profit to zero in the long run. | Because entry is blocked, a monopoly firm can sustain an economic profit in the long run. |
| Efficiency | The equilibrium solution is efficient because price equals marginal cost. | The equilibrium solution is inefficient because price is greater than marginal cost. |

**Table 4.1** Characteristics of perfect competition and monopoly

Public policy toward monopoly generally recognises two important dimensions of the monopoly problem. On one hand, the combining of competing firms into a monopoly creates an inefficient and, to many, inequitable solution. On the other hand, some industries are characterised as natural monopolies; production by a single firm allows economies of scale that result in lower costs.

The combining of competing firms into a monopoly firm or unfairly driving competitors out of business is generally forbidden in the United States. Regulatory efforts to prevent monopoly fall under the purview of the nation's antitrust laws, discussed in more detail in a later section.

At the same time, we must be careful to avoid the mistake of simply assuming that competition is the alternative to monopoly that every monopoly can and should be replaced by a competitive market. One key source of monopoly power, after all, is economies of scale. In the case of natural monopoly, the alternative to a single firm is many small, high-cost producers. We may not like having only one local provider of water, but we might like even less having dozens of providers whose costs — and prices — are higher. Where monopolies exist because economies of scale prevail over the entire range of market demand, they may serve a useful economic role. We might want to regulate their production and pricing choices, but we may not want to give up their cost advantages.

Where a natural monopoly exists, the price charged by the firm and other aspects of its behaviour may be subject to regulation. Water or natural gas, for example, are often distributed by a public utility — a monopoly firm — at prices regulated by a state or local government agency. Typically, such agencies seek to force the firm to charge lower prices, and to make less profit, than it would otherwise seek.

Although economists are hesitant to levy blanket condemnations of monopoly, they are generally sharply critical of monopoly power where no rationale for it exists. When firms have substantial monopoly power only as the result of government policies that block entry, there may be little defence for their monopoly positions.

Public policy toward monopoly aims generally to strike the balance implied by economic analysis. Where rationales exist, as in the case of natural monopoly, monopolies are permitted — and their prices are regulated. In other cases, monopoly is prohibited outright. Societies are likely to at least consider taking action of some kind against monopolies unless they appear to offer cost or other technological advantages.

## The fragility of monopoly power

An important factor in thinking about public policy toward monopoly is to recognise that monopoly power can be a fleeting thing. Firms constantly seek out the market power that monopoly offers. When conditions are right to achieve this power, firms that succeed in carving out monopoly positions enjoy substantial profits. But the potential for high profits invites continuing attempts to break down the barriers to entry that insulate monopolies from competition.

Technological change and the pursuit of profits chip away constantly at the entrenched power of monopolies. Breathtaking technological change has occurred in the telecommunications industry. Catalogue companies are challenging the monopoly positions of some retailers; internet booksellers and online textbook companies such as Flatworldknowledge.com are challenging the monopoly power of your university's bookstore; and Federal Express, UPS, and other companies are taking on the U.S. Postal Service. The assaults on monopoly power are continuous. Thus, even the monopoly firm must be on the lookout for potential competitors.

Potential rivals are always beating at the door and thereby making the monopoly's fragile market contestable — that is, open to entry, at least in the sense of rival firms producing "close enough," if not perfect, substitutes — close enough that they might eliminate the firm's monopoly power.

## Summary

A monopoly firm produces an output that is less than the efficient level. The result is a deadweight loss to society, given by the area between the demand and marginal cost curves over the range of output between the output chosen by the monopoly firm and the efficient output. The higher price charged by the monopoly firm compared to the perfectly competitive firm reduces consumer surplus, part of which is transferred to the monopolist. This transfer generates an equity issue. The monopoly firm's market power reduces consumers' choices and may result in higher prices, but there may be advantages to monopoly as well, such as economies of scale and technological innovations encouraged by the patent system. Public policy toward monopoly consists of antitrust laws and regulation of natural monopolies. Forces that limit the power of monopoly firms are the constant effort by other firms to capture some of the monopoly firm's profits and technological change that erodes monopoly power.

## Self-test 4.3

Does the statement below better describe a firm operating in a perfectly competitive market or a firm that is a monopoly?

1. The demand curve faced by the firm is downward-sloping.
2. The demand curve and the marginal revenue curves are the same.
3. Entry and exit are relatively difficult.
4. The firm is likely to be concerned about antitrust laws.
5. Consumer surplus would be increased if the firm produced more output.

# 4.4 Monopolistic Competition: Competition among Many

## Objectives

By the end of this section, you should be able to:

1. Explain the main characteristics of a monopolistically competitive industry, describing both its similarities and differences from the models of perfect competition and monopoly.

2. Explain and illustrate both short-run equilibrium and long-run equilibrium for a monopolistically competitive firm.

3. Explain what it means to say that a firm operating under monopolistic competition has excess capacity in the long run and discuss the implications of this conclusion.

## Introduction

The first model of an imperfectly competitive industry that we shall investigate has conditions quite similar to those of perfect competition. The model of monopolistic competition assumes a large number of firms. It also assumes easy entry and exit. This model differs from the model of perfect competition in one key respect: it assumes that the goods and services produced by firms are differentiated. This differentiation may occur by virtue of advertising, convenience of location, product quality, reputation of the seller, or other factors. Product differentiation gives firms producing a particular product some degree of price-setting or monopoly power.

However, because of the availability of close substitutes, the price-setting power of monopolistically competitive firms is quite limited. Monopolistic competition is a model characterised by many firms producing similar but differentiated products in a market with easy entry and exit.

Restaurants are a monopolistically competitive sector; in most areas there are many firms, each is different, and entry and exit are very easy. Each restaurant has many close substitutes — these may include other restaurants, fast-food outlets, and the deli and frozen-food sections at local supermarkets. Other industries that engage in monopolistic competition include retail stores, barber and beauty shops, auto-repair shops, service stations, banks, and law and accounting firms.

## Profit maximisation

Suppose a restaurant raises its prices slightly above those of similar restaurants with which it competes. Will it have any customers? Probably. Because the restaurant is different from other restaurants, some people will continue to patronise it. Within limits, then, the restaurant can set its own prices; it does not take the market prices as given. In fact, differentiated markets imply that the notion of a single "market price" is meaningless.

Because products in a monopolistically competitive industry are differentiated, firms face downward sloping demand curves. Whenever a firm faces a downward-sloping demand curve, the graphical framework for monopoly can be used. In the short run, the model of monopolistic competition looks exactly like the model of monopoly. An important distinction between monopoly and monopolistic competition, however, emerges from the assumption of easy entry and exit. In monopolistic competition, entry will eliminate any economic profits in the long run. We begin with an analysis of the short run.

## The short run

Because a monopolistically competitive firm faces a downward-sloping demand curve, its marginal revenue curve is a downward-sloping line that lies below the demand curve, as in the monopoly model.

We can thus use the model of monopoly that we have already developed to analyse the choices of a monopsony in the short run. **Figure 4.8** shows the demand, marginal revenue, marginal cost, and average total cost curves facing a monopolistically competitive firm, Mama's Pizza.

Mama's competes with several other similar firms in a market in which entry and exit are relatively easy. Mama's demand curve $D1$ is downward-sloping; even if Mama's raises its prices above those of its competitors, it will still have some customers. Mama's marginal revenue curve MR1 lies below the demand curve. To sell more pizzas, Mama's must lower its price, and that means its marginal revenue from additional pizzas will be less than price.

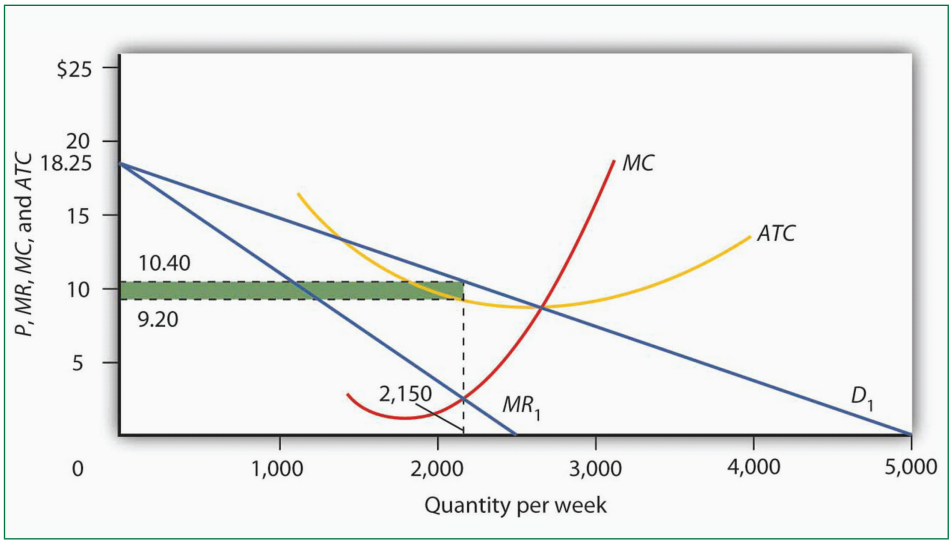



**Figure 4.8** Short-run equilibrium in monopolistic competition

*Looking at the intersection of the marginal revenue curve MR1 and the marginal cost curve MC, we see that the profit-maximising quantity is 2,150 units per week. Reading up to the average total cost curve ATC, we see that the cost per unit equals RM9.20. Price, given on the demand curve D1, is RM10.40, so the profit per unit is RM1.20. Total profit per week equals RM1.20 times 2,150, or RM2,580; it is shown by the shaded rectangle.*

Given the marginal revenue curve MR and marginal cost curve *MC*, Mama's will maximise profits by selling 2,150 pizzas per week. Mama's demand curve tells us that it can sell that quantity at a price of RM10.40. Looking at the average total cost curve ATC, we see that the firm's cost per unit is RM9.20. Its economic profit per unit is thus RM1.20. Total economic profit, shown by the shaded rectangle, is RM2,580 per week.

## The long run

We see in **Figure 4.8** that Mama's Pizza is earning an economic profit. If Mama's experience is typical, then other firms in the market are also earning returns that exceed what their owners could be earning in some related activity. Positive economic profits will encourage new firms to enter Mama's market.

As new firms enter, the availability of substitutes for Mama's pizzas will increase, which will reduce the demand facing Mama's Pizza and make the demand curve for Mama's Pizza more elastic. Its demand curve will shift to the left. Any shift in a demand curve shifts the marginal revenue curve as well. New firms will continue to enter, shifting the demand curves for existing firms to the left, until pizza firms such as Mama's no longer make an economic profit. The zero-profit solution occurs where Mama's demand curve is tangent to its average total cost curve — at point A in **Figure 4.9**. Mama's price will fall to RM10 per pizza and its output will fall to 2,000 pizzas per week.

Mama's will just cover its opportunity costs, and thus earn zero economic profit. At any other price, the firm's cost per unit would be greater than the price at which a pizza could be sold, and the firm would sustain an economic loss. Thus, the firm and the industry are in long-run equilibrium. There is no incentive for firms to either enter or leave the industry.

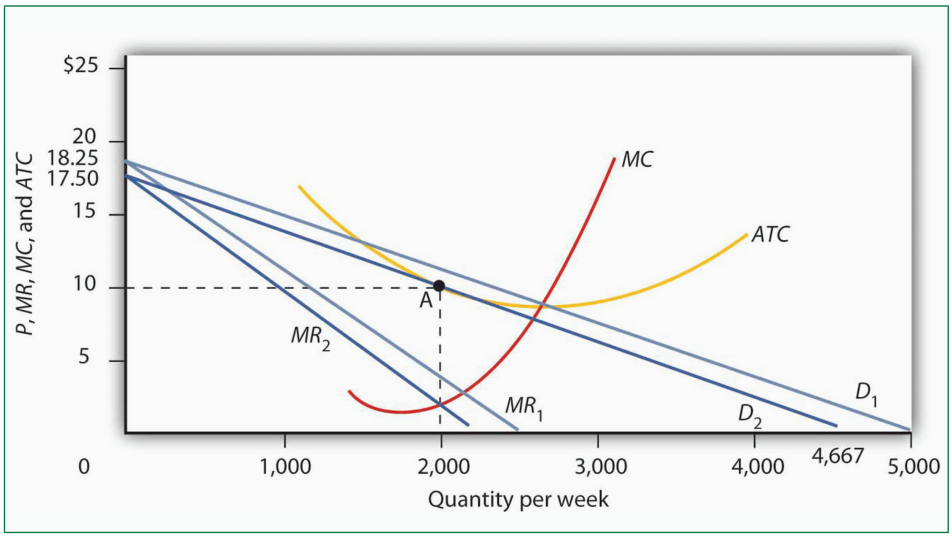



**Figure 4.9** Monopolistic competition in the long run

*The existence of economic profits in a monopolistically competitive industry will induce entry in the long run. As new firms enter, the demand curve D1 and marginal revenue curve MR1 facing a typical firm will shift to the left, to D2 and MR2. Eventually, this shift produces a profit-maximising solution at zero economic profit, where D2 is tangent to the average total cost curve ATC (point A). The long-run equilibrium solution here is an output of 2,000 units per week at a price of RM10 per unit.*

Had Mama's Pizza and other similar restaurants been incurring economic losses, the process of moving to long-run equilibrium would work in reverse. Some firms would exit. With fewer substitutes available, the demand curve faced by each remaining firm would shift to the right. Price and output at each restaurant would rise. Exit would continue until the industry was in long-run equilibrium, with the typical firm earning zero economic profit.

Such comings and goings are typical of monopolistic competition. Because entry and exit are easy, favourable economic conditions in the industry encourage start-ups. New firms hope that they can differentiate their products enough to make a go of it. Some will; others will not. Competitors to Mama's may try to improve the ambience, play different music, offer pizzas of different sizes and types. It might take a while for other restaurants to come up with just the right product to pull customers and profits away from Mama's. But as long as Mama's continues to earn economic profits, there will be incentives for other firms to try.

## Excess capacity: The price of variety

The long-run equilibrium solution in monopolistic competition always produces zero economic profit at a point to the left of the minimum of the average total cost curve. That is because the zero profit solution occurs at the point where the downward-sloping demand curve is tangent to the average total cost curve, and thus the average total cost curve is itself downward-sloping. By expanding output, the firm could lower average total cost. The firm thus produces less than the output at which it would minimise average total cost. A firm that operates to the left of the lowest point on its average total cost curve has excess capacity.

Because monopolistically competitive firms charge prices that exceed marginal cost, monopolistic competition is inefficient. The marginal benefit consumers receive from an additional unit of the good is given by its price. Since the benefit of an additional unit of output is greater than the marginal cost, consumers would be better off if output were expanded. Furthermore, an expansion of output would reduce average total cost. But monopolistically competitive firms will not voluntarily increase output, since for them, the marginal revenue would be less than the marginal cost.

One can thus criticise a monopolistically competitive industry for falling short of the efficiency standards of perfect competition. But monopolistic competition is inefficient because of product differentiation.

Think about a monopolistically competitive activity in your area. Would consumers be better off if all the firms in this industry produced identical products so that they could match the assumptions of perfect competition? If identical products were impossible, would consumers be better off if some of the firms were ordered to shut down on grounds the model predicts there will be “too many” firms? The inefficiency of monopolistic competition may be a small price to pay for a wide range of product choices. Furthermore, remember that perfect competition is merely a model. It is not a goal toward which an economy might strive as an alternative to monopolistic competition.

## Summary

The three main characteristics of a monopolistically competitive firm are: many firms, differentiated products, and relatively easy entry. Monopolistically competitive firms face competition in the form of firms producing differentiated products. This is the key characteristic of a monopolistic firm. Features of a monopolistically competitive firm which are similar to a monopoly are: the demand curve is downward-sloping; and at equilibrium, price is above MC.

Features of a monopolistically competitive firm which are similar to a competitive firm are: $MR = MC$ at the 'profit-maximising quantity'; and zero profit in the long run; that is, at equilibrium, $P = AC$ (average total cost). Monopolistic competition equilibrium is inefficient because: $P > MC$; and there is excess capacity; that is, it does not operate at the level of production where $AC$ is at the minimum level.

## Self-test 4.4

Suppose the monopolistically competitive restaurant industry in your town is in long-run equilibrium, when difficulties in hiring cause restaurants to offer higher wages to cooks, servers, and dishwashers. Using graphs similar to **Figure 4.8** and **Figure 4.9**, explain the effect of the wage increase on the industry in the short run and in the long run. Be sure to include in your answer an explanation of what happens to price, output, and economic profit.

# 4.5 Oligopoly: Competition among the Few

## Objectives

By the end of this section, you should be able to:

1. Explain the main characteristics of an oligopoly, differentiating it from other types of market structures.

2. Explain the measures that are used to determine the degree of concentration in an industry.

3. Explain and illustrate the collusion model of oligopoly.

4. Discuss how game theory can be used to understand the behaviour of firms in an oligopoly.

## Introduction

In July, 2005, General Motors Corporation (GMC) offered "employee discount pricing" to virtually all GMC customers, not just employees and their relatives. This new marketing strategy introduced by GMC obviously affected Ford, Chrysler, Toyota and other automobile and truck manufacturers; Ford matched GMC's employee-discount plan by offering up to RM1,000 to its own employees who convinced friends to purchase its cars and trucks. Ford also offered its customers the same prices paid by its employees. By mid-July, Chrysler indicated that it was looking at many alternatives, but was waiting for GMC to make its next move. Ultimately, Chrysler also offered employee discount pricing.

Toyota had to respond. It quickly developed a new marketing strategy of its own, which included lowering the prices of its cars and offering new financing terms. The responses of Ford, Chrysler, and Toyota to GMC's pricing strategy obviously affected the outcome of that strategy. Similarly, a decision by Procter & Gamble to lower the price of Crest toothpaste may elicit a response from Colgate-Palmolive, and that response will affect the sales of Crest. In an oligopoly, the fourth and final market structure that we will study, the market is dominated by a few firms, each of which recognises that its own actions will produce a response from its rivals and that those responses will affect it.

The firms that dominate an oligopoly recognise that they are interdependent: What one firm does affects each of the others. This interdependence stands in sharp contrast to the models of perfect competition and monopolistic competition, where we assume that each firm is so small that it assumes the rest of the market will, in effect, ignore what it does. A perfectly competitive firm responds to the market, not to the actions of any other firm. A monopolistically competitive firm responds

to its own demand, not to the actions of specific rivals. These presumptions greatly simplify the analysis of perfect competition and monopolistic competition. We do not have that luxury in oligopoly, where the interdependence of firms is the defining characteristic of the market.

Some oligopoly industries make standardised products: steel, aluminium, wire, and industrial tools. Others make differentiated products: cigarettes, automobiles, computers, ready-to-eat breakfast cereal, and soft drinks.

## The collusion model

There is no single model of profit-maximising oligopoly behaviour that corresponds to economists' models of perfect competition, monopoly, and monopolistic competition. Uncertainty about the interaction of rival firms makes specification of a single model of oligopoly impossible. Instead, economists have devised a variety of models that deal with the uncertain nature of rivals' responses in different ways.

In this section we review one type of oligopoly model, the collusion model. After examining this traditional approach to the analysis of oligopoly behaviour, we shall turn to another method of examining oligopolistic interaction: game theory.

Firms in any industry could achieve the maximum profit attainable if they all agreed to select the monopoly price and output and to share the profits. One approach to the analysis of oligopoly is to assume that firms in the industry collude, selecting the monopoly solution.

Suppose an industry is a duopoly, an industry with two firms. **Figure 4.10** shows a case in which the two firms are identical. They sell identical products and face identical demand and cost conditions. To simplify the analysis, we will assume that each has a horizontal marginal cost curve, *MC*. The demand and marginal revenue curves are the same for both firms. We find the combined demand curve for the two firms, *D* combined, by adding the individual demand curves together.

Because one firm's demand curve, *D* firm, represents one-half of market demand, it is the same as the combined marginal revenue curve for the two firms. If these two firms act as a monopoly, together they produce *Q*m and charge a price Pm. This result is achieved if each firm selects its profit-maximising output, which equals 1/2 *Q*m. This solution is inefficient; the efficient solution is price *P*c and output *Q*c, found where the combined market demand curve *D* combined and the marginal cost curve *MC* intersect.

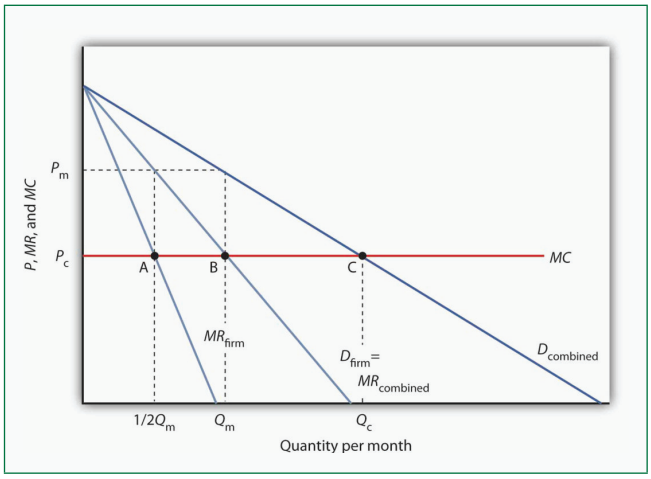



**Figure 4.10** Monopoly through collusion

*Two identical firms have the same horizontal marginal cost curve MC. Their demand curves D firm and marginal revenue curves MR firm are also identical. The combined demand curve is D combined; the combined marginal revenue curve is MR combined. The profits of the two firms are maximised if each produces 1/2 Qm at point A. Industry output at point B is thus Qm and the price is Pm. At point C, the efficient solution output would be Qc, and the price would equal MC.*

In the simplest form of collusion, overt collusion, firms openly agree on price, output, and other decisions aimed at achieving monopoly profits. Firms that coordinate their activities through overt collusion and by forming collusive coordinating mechanisms make up a cartel.

Firms form a cartel to gain monopoly power. A successful cartel can earn large profits, but there are several problems with forming and maintaining one. First, in many countries, including the United States, cartels are generally illegal. They are banned, because their purpose is to raise prices and restrict output. Second, the cartel may not succeed in inducing all firms in the industry to join. Firms that remain outside the cartel can compete by lowering price, and thus they prevent the cartel from achieving the monopoly solution. Third, there is always an incentive for individual members to cheat on cartel agreements. Suppose the members of a cartel have agreed to impose the monopoly price in their market and to limit their output accordingly. Any one firm might calculate that it could charge slightly less than the cartel price and thus capture a larger share of the market for itself. Cheating firms expand output and drive prices down below the level originally chosen.

The Organization of Petroleum Exporting Countries (OPEC), perhaps the best-known cartel, is made up of 13 oil-producing countries. In the 1970s, OPEC successfully acted like a monopoly by restricting output and raising prices. By the mid-1980s, however, the monopoly power of the cartel had been weakened by expansion of output by non-member producers such as Mexico and Norway and by cheating among the cartel members.

An alternative to overt collusion is tacit collusion, an unwritten, unspoken understanding through which firms agree to limit their competition. Firms may, for example, begin following the price leadership of a particular firm, raising or lowering their prices when the leader makes such a change. The price leader may be the largest firm in the industry, or it may be a firm that has been particularly good at assessing changes in demand or cost. At various times, tacit collusion has been alleged to occur in a wide range of industries, including steel, cars, and breakfast cereals.

It is difficult to know how common tacit collusion is. The fact that one firm changes its price shortly after another one does cannot prove that a tacit conspiracy exists. After all, we expect to see the prices of all firms in a perfectly competitive industry moving together in response to changes in demand or production costs.

## Game theory and oligopoly behaviour

Oligopoly presents a problem in which decision makers must select strategies by taking into account the responses of their rivals, which they cannot know for sure in advance. A choice based on the recognition that the actions of others will affect the outcome of the choice and that takes these possible actions into account is called a strategic choice. Game theory is an analytical approach through which strategic choices can be assessed.

Among the strategic choices available to an oligopoly firm are pricing choices, marketing strategies, and product-development efforts. An airline's decision to raise or lower its fares — or to leave them unchanged — is a strategic choice. The other airlines' decision to match or ignore their rival's price decision is also a strategic choice. IBM boosted its share in the highly competitive personal computer market in large part because a strategic product-development strategy accelerated the firm's introduction of new products.

Once a firm implements a strategic decision, there will be an outcome. The outcome of a strategic decision is called a payoff. In general, the payoff in an oligopoly game is the change in economic profit to each firm.

The firm's payoff depends partly on the strategic choice it makes and partly on the strategic choices of its rivals. Some firms in the airline industry, for example, raised their fares in 2005, expecting to enjoy increased profits as a result. They changed their strategic choices when other airlines chose to slash their fares, and all firms ended up with a payoff of lower profits — many went into bankruptcy.

We shall use two applications to examine the basic concepts of game theory. The first examines a classic game theory problem called the prisoners' dilemma. The second deals with strategic choices by two firms in a duopoly.

## The prisoners' dilemma

Suppose a local district attorney (DA) is certain that two individuals, Frankie and Johnny, have committed a burglary, but she has no evidence that would be admissible in court.

The DA arrests the two. On being searched, each is discovered to have a small amount of cocaine. The DA now has a sure conviction on a possession of cocaine charge, but she will get a conviction on the burglary charge only if at least one of the prisoners confesses and implicates the other.

The DA decides on a strategy designed to elicit confessions. She separates the two prisoners and then offers each the following deal: "If you confess and your partner doesn't, you will get the minimum sentence of one year in jail on the possession and burglary charges. If you both confess, your sentence will be three years in jail. If your partner confesses and you do not, the plea bargain is off and you will get six years in prison. If neither of you confesses, you will each get two years in prison on the drug charge."

The two prisoners each face a dilemma; they can choose to confess or not confess. Because the prisoners are separated, they cannot plot a joint strategy. Each must make a strategic choice in isolation.

The outcomes of these strategic choices, as outlined by the DA, depend on the strategic choice made by the other prisoner. The payoff matrix for this game is given in **Figure 4.11**. The two rows represent Frankie's strategic choices; she may confess or not confess. The two columns represent Johnny's strategic choices; he may confess or not confess.

There are four possible outcomes: Frankie and Johnny both confess (cell A), Frankie confesses but Johnny does not (cell B), Frankie does not confess but Johnny does (cell C), and neither Frankie nor Johnny confesses (cell D). The portion at the lower left in each cell shows Frankie's payoff; the shaded portion at the upper right shows Johnny's payoff.

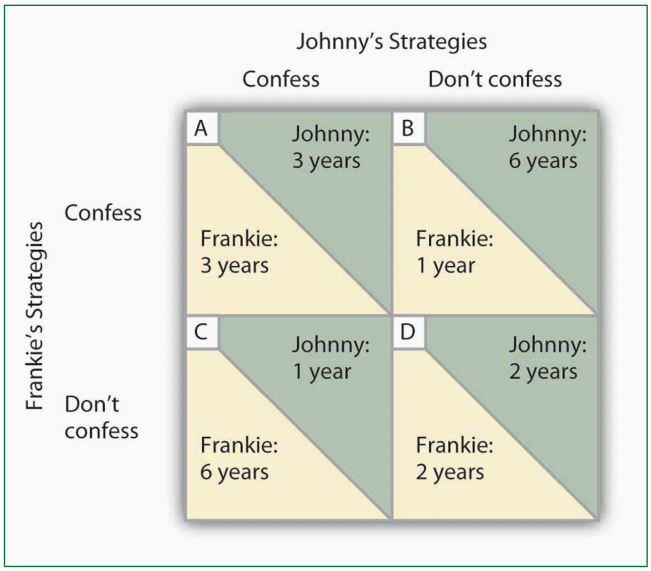



**Figure 4.11** Payoff matrix for the prisoners' dilemma

*The four cells represent each of the possible outcomes of the prisoners' game.*

If Johnny confesses, Frankie's best choice is to confess — she will get a three-year sentence rather than the six-year sentence she would get if she did not confess. If Johnny does not confess, Frankie's best strategy is still to confess — she will get a one-year rather than a two-year sentence. In this game, Frankie's best strategy is to confess, regardless of what Johnny does. When a player's best strategy is the same regardless of the action of the other player, that strategy is said to be a dominant strategy.

Frankie's dominant strategy is to confess to the burglary. For Johnny, the best strategy to follow, if Frankie confesses, is to confess. The best strategy to follow if Frankie does not confess is also to confess. Confessing is a dominant strategy for Johnny as well. A game in which there is a dominant strategy for each player is called a dominant strategy equilibrium. Here, the dominant strategy equilibrium is for both prisoners to confess; the payoff will be given by cell A in the payoff matrix.

From the point of view of the two prisoners together, a payoff in cell D would have been preferable. Had they both denied participation in the robbery, their combined sentence would have been four years in prison — two years each. Indeed, cell D offers the lowest combined prison time of any of the outcomes in the payoff matrix. But because the prisoners cannot communicate, each is likely to make a strategic choice that results in a more costly outcome. Of course, the outcome of the game depends on the way the payoff matrix is structured.

## Duopoly: An example

We will keep the game simple, however, and consider a duopoly game. The two firms have colluded, either tacitly or overtly, to create a monopoly solution. As long as each player upholds the agreement, the two firms will earn the maximum economic profit possible in the enterprise.

There will, however, be a powerful incentive for each firm to cheat. The monopoly solution may generate the maximum economic profit possible for the two firms combined, but what if one firm captures some of the other firm's profit? Suppose, for example, that two equipment rental firms, Quick Rent and Speedy Rent, operate in a community. Given the economies of scale in the business and the size of the community, it is not likely that another firm will enter. Each firm has about half the market and they have agreed to charge the prices that would be chosen if the two combined as a single firm. Each earns economic profits of $20,000 per month.

Quick and Speedy could cheat on their arrangement in several ways. One of the firms could slash prices, introduce a new line of rental products, or launch an advertising blitz. This approach would not be likely to increase the total profitability of the two firms, but if one firm could take the other by surprise, it might profit at the expense of its rival, at least for a while.

We will focus on the strategy of cutting prices, which we will call a strategy of cheating on the duopoly agreement. The alternative is not to cheat on the agreement. Cheating increases a firm's profits if its rival does not respond.

**Figure 4.12** shows the payoff matrix facing the two firms at a particular time. As in the prisoners' dilemma matrix, the four cells list the payoffs for the two firms. If neither firm cheats (cell D), profits remain unchanged.

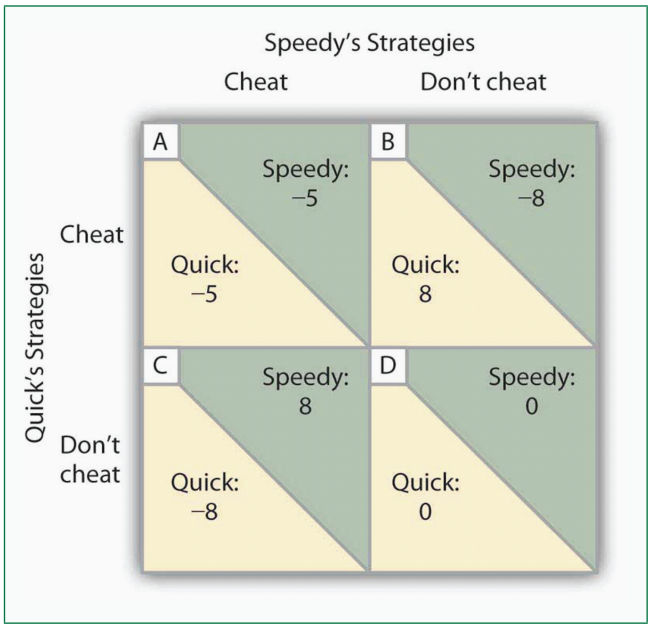



**Figure 4.12** To cheat or not to cheat: Game theory in oligopoly

*Two rental firms, Quick Rent and Speedy Rent, operate in a duopoly market. They have colluded in the past, achieving a monopoly solution. Cutting prices means cheating on the arrangement; not cheating means maintaining current prices. The payoffs are changes in monthly profits, in thousands of dollars. If neither firm cheats, then neither firm's profits will change. In this game, cheating is a dominant strategy equilibrium.*

This game has a dominant strategy equilibrium. Quick's preferred strategy, regardless of what Speedy does, is to cheat. Speedy's best strategy, regardless of what Quick does, is to cheat. The result is that the two firms will select a strategy that lowers their combined profits!

Quick Rent and Speedy Rent face an unpleasant dilemma. They want to maximise profit, yet each is likely to choose a strategy inconsistent with that goal. If they continue the game as it now exists, each will continue to cut prices, eventually driving prices down to the point where price equals average total cost (presumably, the price-cutting will stop there). But that would leave the two firms with zero profits.

Both firms have an interest in maintaining the status quo of their collusive agreement. Overt collusion is one device through which the monopoly outcome may be maintained, but that is illegal. One way for the firms to encourage each other not to cheat is to use a tit-for-tat strategy. In a tit-for-tat strategy a firm responds to cheating by cheating, and it responds to cooperative behaviour by cooperating. As each firm learns that its rival will respond to cheating by cheating, and to cooperation by cooperating, cheating on agreements becomes less and less likely.

Still another way firms may seek to force rivals to behave cooperatively rather than competitively is to use a trigger strategy, in which a firm makes clear that it is willing and able to respond to cheating by permanently revoking an agreement. A firm might, for example, make a credible threat to cut prices down to the level of average total cost — and leave them there — in response to any price-cutting by a rival. A trigger strategy is calculated to impose huge costs on any firm that cheats — and on the firm that threatens to invoke the trigger. A firm might threaten to invoke a trigger in hopes that the threat will prevent any cheating by its rivals.

Game theory has proved to be an enormously fruitful approach to the analysis of a wide range of problems. Corporations use it to map out strategies and to anticipate rivals' responses. Governments use it in developing foreign-policy strategies. Military leaders play war games on computers using the basic ideas of game theory. Any situation in which rivals make strategic choices to which competitors will respond can be assessed using game theory analysis.

## Summary

The key characteristics of oligopoly are recognition that the actions of one firm will produce a response from rivals and that these responses will affect it. Each firm is uncertain what its rivals' responses might be. One way to avoid the uncertainty firms face in oligopoly is through collusion. Collusion may be overt, as in the case of a cartel, or tacit, as in the case of price leadership. Game theory is a tool that can be used to understand strategic choices by firms. Firms can use tit-for-tat and trigger strategies to encourage cooperative behaviour by rivals.

## Self-test 4.5

Which model of oligopoly would seem to be most appropriate for analyzing firms' behaviour in each of the situations given below?

1. When AirAsia lowers its fare between Penang and Kuala Lumpur, Malindo air lowers its fare between the two cities. When AirAsia raises its fare, Malindo Air does the same too.

2. Whenever Bank A raises interest rates on car loans, other banks in the area do too.

3. In 1986, Saudi Arabia intentionally flooded the market with oil in order to punish fellow OPEC members for cheating on their production quotas.

4. In July 1998, Saudi Arabia floated a proposal in which a group of eight or nine major oil-exporting countries (including OPEC members and some non-members, such as Mexico) would manage world oil prices by adjusting their production.

# Summary of Unit 4

**Summary**

This unit started with an introduction to monopoly as a market structure. As we have seen, monopoly power exists when there is only on firm in the market. Some firms exhibit monopoly power when they have control over the market. This usually occurs in the short-run. We went on to analyse the monopolistic firm which produces differentiated products. This market structure displays similar traits to perfectly competitive firms. The products are homogenous to a certain extent as efforts are put in to differentiate the products of one firm over another. We ended our discussion of the unit with a look at oligopoly firms. Oligopoly firms are notorious for the ability to determine both its price and quantity, something that cannot be done by any other firm. The strategic plays of the firms in this form of market structure led by theories of game makes this section rather interesting to study.

# Suggested Answers to Self-tests

## Feedback

### Self-test 4.1

1. The government's grant of an exclusive franchise to the drug gave the firm monopoly power.

2. While Ali and Abu have the only shop in town, this is an easy entry business. Further, there may be competitors in the nearby town. Ali and Abu probably have monopoly power, but they do not have a monopoly.

3. Natural monopoly

4. Patent

### Self-test 4.2

1. Maintenance costs constitute the variable costs associated with building the road. In order to answer the first four parts of the question, you will need to compute total revenue, marginal revenue, and marginal cost, as shown below:

| | | | | | | |
|---|---|---|---|---|---|---|
| Price per trip | $1.00 | 0.90 | 0.80 | 0.70 | 0.60 | 0.50 |
| Number of trips per year (in millions) | 1 | 2 | 3 | 4 | 5 | 6 |
| Total variable costs per year (in millions) | $0.7 | 1.2 | 1.8 | 2.9 | 4.2 | 6.0 |
| Total revenue (in millions) | $1.00 | 1.80 | 2.40 | 2.80 | 3.00 | 3.00 |
| Marginal revenue | | $0.80 | 0.60 | 0.40 | 0.20 | 0.00 |
| Marginal cost | | $0.50 | 0.60 | 1.10 | 1.30 | 1.80 |

Profit-maximising level of output is at 3 million trips per year as marginal revenue equals marginal costs at RM0.60.

2. Price of trip at the profit-maximising level output is at RM0.80

3. Marginal revenue is RM0.60 which will always be lower than the price in a monopoly.

**Self-test 4.3**

1. monopoly
2. perfect competition
3. monopoly
4. monopoly
5. monopoly

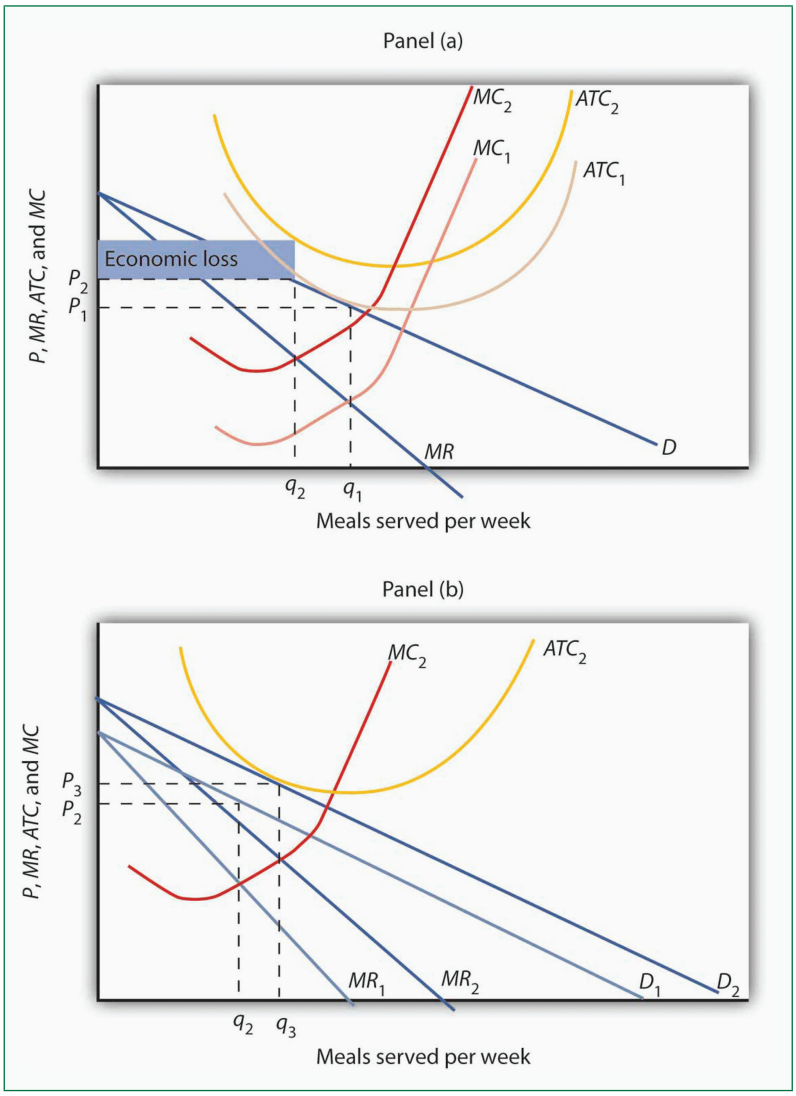
**Self-test 4.4**

As shown in Panel (a), higher wages would cause both *MC* and *ATC* to increase. The upward shift in *MC* from *MC*1 to *MC*2 would cause the profit-maximising level of output (number of meals served per week, in this case) to fall from *q*1 to *q*2 and price to increase from *P*1 to *P*2. The Increase in *ATC* from *ATC*1 to *ATC*2 would mean that some restaurants would be earning negative economic profits, as shown by the shaded area. As shown in Panel (b), in the long run, as some restaurants close down, the demand curve faced by the typical remaining restaurant would shift to the right from *D*1 to *D*2. The demand curve shift leads to a corresponding shift in marginal revenue from *MR*1 to *MR*2. Price would increase further from *P*2 to *P*3, and output would increase to *q*3, above *q*2. In the new long-run equilibrium, restaurants would again be earning zero economic profit.

**Self-test 4.5**

1. AirAsia seems to be practicing a price strategy known in game theory as tit-for- tat.

2. The banks could be engaged in tacit collusion, with Bank A as the price leader.

3. Saudi Arabia appears to have used a trigger strategy, another aspect of game theory. In general, of course, participants hope they will never have to "pull" the trigger, because doing so harms all participants. After years of cheating by other OPEC members, Saudi Arabia did undertake a policy that hurt all members of OPEC, including itself; OPEC has never since regained the prominent role it played in oil markets.

4. Saudi Arabia seems to be trying to create another oil cartel, a form of overt collusion.