7 COSTS, REVENUES AND PROFIT (HL ONLY)

7.1 Costs of production: economic costs

Learning outcomes

- Explain the meaning of economic costs as the opportunity cost of all resources employed by the firm (including entrepreneurship).
- Distinguish between explicit costs and implicit costs as the two components of economic costs.

In their effort to minimize costs, firms often cut corners, as BP may have done on its oil rig *Deepwater Horizon*, seen here after an explosion in summer 2010.

On 20 April 2010, *Deepwater Horizon*, an oil rig in the Gulf of Mexico, burst into flames following the failure of a pressure-release valve on the seabed 5000 feet below the surface. The rig sank and the deep-sea well proceeded to spew between 10 000 and 20 000 barrels of oil per day into the Gulf. By the time the well was sealed months later, over 100 million gallons of oil had leaked into the Gulf of Mexico, making this the largest oil spill and one of the worst environmental catastrophes in American history.

About two months after the rig's failure, evidence emerged that, when building the well, BP may have made cost-cutting decisions that contributed to its eventual failure.

The company made a series of money-saving shortcuts and blunders that dramatically increased the danger of a destructive oil spill in a well that an engineer ominously described as a 'nightmare' just six days before the blowout, according to documents … that provide new insight into the causes of the disaster.

'Time after time, it appears that BP made decisions that increased the risk of a blowout to save the company time or expense. If this is what happened, BP's carelessness and complacency have inflicted a heavy toll on the Gulf, its inhabitants, and the workers on the rig', said Democratic Representatives Henry A Waxman and Bart Stupak …

In the design of the well, the company apparently chose a riskier option among two possibilities to provide a barrier to the flow of gas in space surrounding steel tubes in the well, documents and internal emails show. The decision saved BP $7 million to $10 million; the original cost estimate for the well was about $96 million.

Mathew Daly and Ray Henry, Associated Press writers

BP's decision to minimize costs in the construction of its oil well seems foolish in retrospect. The current estimate of monetary damages BP will have to pay to victims of the oil spill is in the range of $40 billion, 4000 times more than the company saved by choosing the lower-cost option when building the well. So why did BP do it? What drives firms to reduce costs at every opportunity, even if it may lead to a lower-quality product or the risk of future engineering failures as with BP's oil well? This chapter and the three that follow examine the theories surrounding the behaviour of firms in market economies.

Businesses, like individuals, respond to incentives in the pursuit of their economic objectives. The goal of individual consumers in a market economy is to maximize their utility or happiness which, in the economic realm, is achieved through increased consumption of goods and services made possible through increased income. Individuals, therefore, seek to maximize their incomes by selling their productive resources (land, labour and capital) to those firms which demand them in the resource market.

Firms, on the other hand, seek to maximize their profits through the production and sale of their various goods and services in the product market. The interaction of firms and individuals in the resource and product markets is the defining activity of the market economic system. In the pursuit of their goal of profit maximization, firms must accomplish two distinct objectives: *reducing costs* and *increasing revenues* until the difference between the two (the *profit*) is maximized.

Costs in economics are those things that must be given up in order to have something else. Costs can be explicit or implicit. Explicit costs are the monetary payments that firms make to the owners of land, labour and capital in the resource market (i.e. rent, wages and interest, respectively). Implicit costs include the opportunity costs of entrepreneurs who decide to allocate their time and energy to one enterprise over other possible economic activities (in economics, the implicit cost of an entrepreneur is called normal profit).

Revenue is the income earned from a firm's sale of its good or service to consumers in the product market.

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A firm's *profit* is the difference between its total revenue (TR) earned in product market and its total cost (TC) in the resource market, as shown in the following equation:

Profit = TR – TC

Profit is the difference between a firm's total revenues and its total costs.

A key concept we must understand as we begin our study of firm behaviour is that most firms are profit maximizers, which requires them to be cost minimizers. This is because the difference between a firm's revenues and its costs are its profit.

To return to our question: Why would BP choose the cheaper and inferior component for its oil well rather than the more costly yet superior part? The answer is that BP made the decision in the best interests of its shareholders at the time. Corporations like BP are actually legally bound to maximize profits, which requires them to minimize their costs whenever the opportunity arises.

The late Nobel Prize-winning economist Milton Friedman reflected on the responsibilities of corporations:

There is one and only one social responsibility of business – to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game.

…

And further:

The only entities who can have responsibilities are individuals … A business cannot have responsibilities. So the question is, do corporate executives, provided they stay within the law, have responsibilities in their

business activities other than to make as much money for their stockholders as possible? And my answer to that is, no, they do not.

Milton Friedman, *Business & Society Review*

BP did not act out of greed or disregard for the well-being of others when it saved $10 million while building its well. It acted in the best interests of the members of the public who held shares in the company, as it is legally bound to do, by minimizing costs in order to maximize profits.

In this chapter, you will consider the various costs, both short run and long run, explicit and implicit that firms face in their effort to maximize profits. You will examine normal profit and economic profit, and consider the 'rule' that firms must follow in determining their profit-maximizing level of output and price. In the chapters that follow, you will examine different market structures (ranging from highly competitive to monopolistic) and the behaviours of firms in each type of market.

The short run is the period of time during which the number of firms in an industry and the amount of land and capital employed by existing firms towards the production of a good are fixed in quantity.

In the long run, the number of firms and the amount of capital used in production by existing firms are variable. This means that as demand grows, firms increase capital and new firms enter a market in the long run. If demand falls for a particular good, in the long run, the amount of capital used by firms and the number of firms in a market may be reduced.

Explicit and implicit costs of production

We've already distinguished between two distinct microeconomic time periods, the short run and the long run. The short run is defined as the period of time over which firms cannot acquire land or capital resources to increase production or take land or capital out of production, but within which labour can be applied to a greater or lesser degree in order to change output. The only variable resource in the short run is labour. In the long run, firms are able to acquire and put into production all factors of production – labour, land, capital and other resources – to produce output. In the long run, all resources are variable.

The short run is also known as the fixed-plant period, since the amount of capital a firm employs (otherwise known as its plant size) is fixed. The long run is also known as the variable-plant period, since the amount of all resources, including capital, can be adjusted in the long run.

In understanding the cost-minimizing behaviour of firms, we need to distinguish short-run costs of production from long-run costs of production. In the short run, a firm may alter the amount of labour and raw materials it employs towards its production of output, but not the amount of capital or land. The short-run costs faced by firms can be either explicit or implicit.

Explicit costs

Explicit costs are the monetary payments a firm makes to the owners of the resources it employs in the production of its output. Wages for workers, raw material costs, energy and transport costs, rent payments for factory or retail space and interest payments to banks are all explicit costs a firm may face.

Implicit costs

Implicit costs refer to the opportunity costs faced by the entrepreneur who undertakes a business venture and who could otherwise have earned money by hiring his self-owned resources out to another employer. The founders of all business enterprises face implicit costs that represent the foregone wages of the entrepreneur who chose to start a business as opposed to earning a wage working for someone else. Also considered an implicit cost is the normal profit an entrepreneur expects to earn above and beyond all his or her explicit costs. Normal profit is the entrepreneur's implied value of his or her own talent; it is the cost to do business, and if a firm's revenues do not cover the normal profit, the firm owner may choose to shut down and direct his or her efforts towards another industry or area of employment.

Implicit costs are the opportunity costs faced by a business owner who chooses to use his skills and resources to operate his own enterprise rather than seek employment by someone else. A business's implicit cost is also known as its normal profit.

Explicit costs are the monetary payments a firm makes to the owners of the resources it employs in its production.

The difference between implicit and explicit costs

To demonstrate the difference between explicit and implicit costs, imagine a PhD chemist who chooses to leave her job paying €100 000 at a pharmaceutical company to start her own research firm. Her explicit costs as a new business owner are the wages she must pay herself and her five researchers, the rent she pays for her lab space, and the interest she pays the bank for the loans she took out to acquire equipment for her laboratory.

The chemist's implicit cost is her perceived value of her entrepreneurial talent, represented by the profit she expects to earn above and beyond her old salary to compensate her for the risk she took when starting her own business. Assume the chemist expects to earn the €100 000 she sacrificed when she left her old job, plus an additional €50 000 to compensate her for the risk she took by starting her own lab. The €50 000 is her normal profit, which she must earn in order for her to consider the venture worth her while.

A mnemonic for implicit and explicit costs: WIRP

- **W** – Wages are the monetary payments a firm faces as it pays its workers for their labour. Wages are an explicit short-run variable cost, since the quantity of labour employed by a firm can vary in the short run.
- **I** – Interest is the explicit cost faced by a firm for its use of capital. Interest must be paid on the loans firms take out to acquire capital. Additionally, by investing the revenues it earns in new capital, a firm forgoes the interest payments it could have received by investing its revenues in other assets such as bonds or savings accounts. Interest payments are typically a fixed cost in the short run, since capital is fixed in the short run, but variable in the long run as a firm is able to employ more or less capital in the long run.
- **R** – Rent is the explicit cost of land resources. A business owner who employs his own land resources forgoes the rent he could have earned by leasing his land to another tenant, and businesses that do not own their own land must rent space on which to produce their goods or services. Rent is a fixed cost in the short run, since land is a fixed resource, but variable in the long run as a firm is able to vary the amount of land it uses in the production of its output over time.
- **P** – Profit, or normal profit, is the implicit cost an entrepreneur must cover in order to remain in business. The level of normal profit may vary from entrepreneur to entrepreneur. For instance, a mechanic who leaves an auto garage to start his own oil-changing business may have a level of normal profit that is much lower than the chemist who leaves a lucrative job at a pharmaceutical company. The chemist expects to earn a much greater return beyond her explicit costs than the mechanic whose skills and talents are less scarce and are deemed to be of lower monetary value in the marketplace.

To learn more about costs of production, visit www.pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 7.1.

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7.2 Production in the short run: law of diminishing marginal returns

Learning outcomes

- Distinguish between the short run and long run in the context of production.
- Define total product, average product and marginal product, and construct diagrams to show their relationship.
- Explain the law of diminishing returns.
- Calculate total, average and marginal product from a set of data and/or diagrams.
- Explain the distinction between the short run and the long run, with reference to fixed costs and variable costs.
- Distinguish between total costs, marginal costs and average costs.
- Draw diagrams illustrating the relationship between marginal costs and average costs, and explain the connection with production in the short run.
- Explain the relationship between the product curves (average product and marginal product) and the cost curves (average variable cost and marginal cost) with reference to the law of diminishing returns.

At its peak in the mid-2000s, Krispy Kreme Doughnuts had stores in 18 countries.

Krispy Kreme started out as a single shop in North Carolina in the 1930s, employing only a few workers and providing doughnuts to hundreds of happy customers.

As the business's popularity grew, it did not begin opening new shops right away. In the short run, Krispy Kreme simply hired more workers and asked its existing employees to work longer hours. Doughnut makers who worked part time were given full-time jobs, and the shop extended its hours so it was open longer each day. Thus, in the short run, Krispy Kreme varied only the quantity of labour it employed in doughnut production, not the quantity of capital or land. In other words, until Krispy Kreme had time to open a second doughnut shop and fill it with new deep fryers and ovens, the company could only respond to the rising demand of its customers by varying the quantity of labour employed on its fixed capital and land.

Krispy Kreme's short-run costs of production included only those that changed in the period of time before the business opened its second doughnut shop, specifically the costs of its raw materials and the labour it had to employ to meet the rising demand for its doughnuts.

A firm's labour cost (the wages it pays its workers) is the primary variable cost a firm faces in the short run. To understand how a firm's variable costs change in the short run, we must understand how the productivity of the short-run variable resource, labour, changes as workers are added to or taken away from a fixed quantity of capital and land.

Productivity is defined as the amount of output attributable to a unit of input. Highly productive resources result in lower costs for firms, while low productivity means firms' costs will be higher. Naturally, a firm wishes to maximize the productivity of its resources in order to minimize its costs. In the case of Krispy Kreme, all new employees had to

undergo several days of training to learn how to use the equipment in the kitchen. This meant that when an employee began making doughnuts, he was highly productive and made as many doughnuts as possible during each hour of his labour, thus keeping Krispy Kreme's per-unit costs low and its profit margin high.

The law of diminishing returns

To determine how a firm's costs change as it varies its level of production in the short run, let's examine the effect that a change in the quantity of labour has on a firm's output given that land and capital resources remain fixed in quantity.

Imagine a doughnut shop with one oven and two fryers. These machines are the firm's capital. Its land is the shop itself. In order to increase production of doughnuts in the short run, the firm can hire more workers and use more doughnut ingredients, but it cannot open a new shop or employ more capital. How will the output of doughnuts (the total product) change as more workers are employed, and why? Table 7.1 represents the output of one doughnut shop with three machines as it goes from employing zero workers to eight workers.

TABLE 7.1 SHORT-RUN PRODUCTION RELATIONSHIPS

Number of workers (Q_L)	Number of machines (Q_K)	Total product (TP)	Marginal product (MP = $\Delta TP/\Delta Q_L$)	Average product (AP = TP/Q_L)
0	3	0	–	–
1	3	4	4	4
2	3	9	5	4.5
3	3	15	6	5
4	3	20	5	5
5	3	24	4	4.8
6	3	26	2	4.33
7	3	26	0	3.7
8	3	24	-2	3

Table 7.1 tells us how the doughnut shop's total product (TP, the output of doughnuts per hour) changes as workers are added to a fixed amount of capital. It also shows us the firm's marginal product (MP), which is the change in the total product attributable to the last worker hired, and its average product (AP), which is the output per worker.

$$MP = \frac{\Delta TP}{\Delta Q_L}$$

$$AP = \frac{TP}{Q_L}$$

HL EXERCISES

Using Table 7.1, answer the following questions.

1. What is the firm's total product when $Q_L = 0$? Why is this the case?
2. **a** What happens to total product as the firm hires its first, second and third workers?
   b What about when it hires the sixth, seventh and eighth workers?
   c Why does the growth in total product decline when the last three workers are hired compared to the first three workers?
3. What is the relationship between the marginal product of labour and the total product?
4. At what point does the marginal product of labour stop increasing and begin declining? Why does marginal product eventually decline?

How did you get on? Let's examine what happens as the first, second and third workers are added to the one oven and two fryers in the doughnut shop.

- Without any workers, when Q_L is zero, the business won't make any doughnuts because, well, the machines can't operate themselves.
- When one worker is added, total output is four doughnuts per hour.
- The second and third workers cause output to increase to 9 and 15 doughnuts, respectively.
- The change in total product for the second and third workers, which is the marginal product, increased with each worker added. The second and third workers resulted in increasing marginal returns.

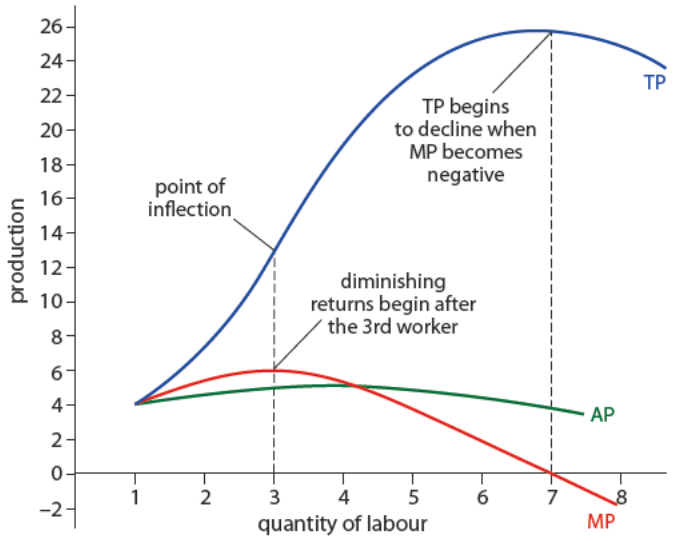
Increasing marginal returns in the doughnut shop are explained by understanding that with fewer than three workers, the existing capital was not being used efficiently nor to its full capacity. With three workers, the machines are used efficiently, so from one to three workers, the marginal returns to labour are increasing, meaning that the output attributable to each additional worker is greater than the output attributable to the previous worker hired.

Now let's observe what happens as the fourth, fifth, sixth, seventh and eighth workers are added to the business.

- Beyond three workers, additional workers hired continue to increase total product for a while, but at a decreasing rate. In other words, the marginal product of labour decreases beyond three workers. The doughnut shop begins to experience diminishing marginal returns.
- With only three machines, the fourth, fifth and sixth workers are able to contribute less and less additional output to the doughnut shop's production. The kitchen is literally getting too crowded to allow for continued increases in productivity.
- Beyond six workers, additional labour adds nothing to total output. The eighth worker actually causes the total output of doughnuts to fall, indicating that his presence simply interferes with, rather than contributes to, the production of doughnuts.

Graphically, our doughnut shop's production data is shown in Figure 7.1.

Figure 7.1
Total, average and marginal production relationships in the short run.



Marginal returns to labour begin to diminish beyond the third worker, becoming negative with the eighth worker. The law of diminishing returns states that as additional units of a variable resource (in this case, labour) are added to fixed resources (land and capital), beyond a certain point the marginal product of the variable resource will decline.

When a firm wishes to expand in the short run, it can hire more workers and ask its existing employees to work longer hours. But if a firm wishes to grow in the long run, it can only do so by adding more capital. The law of diminishing returns explains the shapes of the total, marginal and average product curves in Figure 7.1.

The law of diminishing returns shows that as more and more of a variable resource (typically labour) is added to fixed resources (capital and land), beyond a certain point the productivity of additional units of the variable resource declines. Because the amount of capital is fixed, more workers find it harder to continually add to the firm's output, so they become less productive as they are added in the short run. The law of diminishing returns explains the shapes of a firm's short-run labour productivity curves (and its short-run cost curves, page 158).

The relationship between marginal and total product

Figure 7.1 shows that the value of MP at any level of employment is given by the slope of the TP curve at that point. As long as the MP is positive, additional workers are adding to TP and output continues to increase. Beyond the seventh worker, MP becomes negative as additional workers lead to a fall in TP. While MP is increasing, between the first and third worker, the doughnut shop experiences increasing marginal returns to labour and the slope of TP becomes steeper. But beyond the third worker, the doughnut shop experiences diminishing marginal returns because the productivity of labour declines as it is added to the fixed capital and the slope of TP changes as it rises less steeply prior to levelling out.

The relationship between marginal and average product

The AP curve shows us the output per worker at each level of employment. There is a clear relationship between marginal product and average product. Whenever MP is greater than AP, AP increases. If MP is less than AP, AP falls. This is shown in Figure 7.2 and Table 7.2.

Look closely at the selection of the shop's production table below to understand the relationship between marginal and average product.

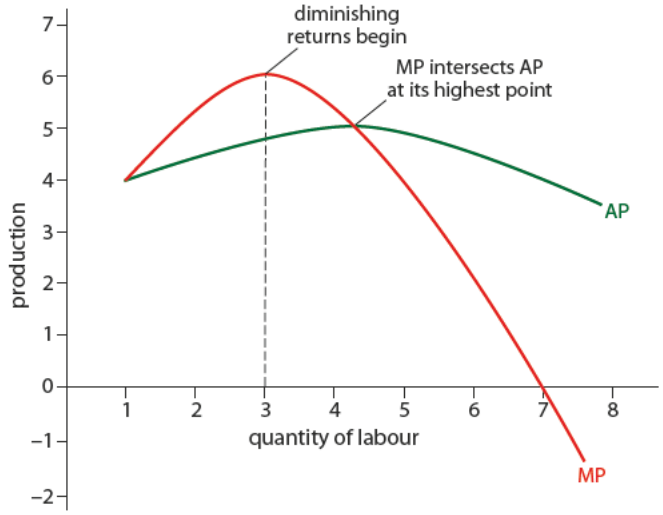


Figure 7.2
Marginal and average product in the short run.

TABLE 7.2 MARGINAL AND AVERAGE PRODUCT IN THE SHORT RUN

Number of workers (Q_L)	Marginal product (MP)	Average product (AP)
1	4	4
2	5	4.5
3	6	5
4	5	5
5	4	4.8

Examiner's hint

One way to understand the relationship between MP and AP is to imagine a non-economic scenario in which a change on the margin affects the average. For instance, you may be at a school that uses percentages to determine grades on tests, quizzes and other assignments. Imagine that up until now your average percentage grade on tests is 80%. If, on the next test you take, your grade were 90%, how would this affect your average? The obvious answer is that your average would increase.

If, on the other hand, you earn 70% on your next test, your average will decrease. The score you earn on your next test is your marginal score. If your score on the margin is higher than your average score, your average will increase; if it is lower than your average score, your average will decrease. This is precisely the relationship that exists between marginal product and average product, and it also holds true for marginal and average cost.

- When the doughnut shop employs two workers, the MP of the second worker is 5 doughnuts and the AP increases from 4 to 4.5 doughnuts, a clear increase.
- The additional output attributable to the third worker is 6 doughnuts and the average output subsequently increases from 4.5 to 5 doughnuts. When an additional worker adds more to output than the average worker, the average must increase.
- When the fourth worker is hired, he adds only 5 additional doughnuts, and since this is the same as the average output with three workers, the average does not change.
- With the fifth worker, however, the marginal product has decreased to 4 doughnuts and the average output therefore begins to decline, to 4.8 doughnuts. The fifth worker hired produces less than the average so the average falls.

Whenever MP is greater than AP, the average will increase. When MP is the same as AP, the average stays the same, and when MP is less than the AP, the average declines. Notice that graphically, the MP curve intersects the AP curve at the latter's highest point. Later in this chapter, you will notice that the same relationship holds true for marginal cost and average cost (page 160).

There are some important points to notice on Figure 7.3.

Figure 7.3a plots TP and Figure 7.3b shows MP and AP. The graphs include some important points to understand about the relationships between these three productivity measures.

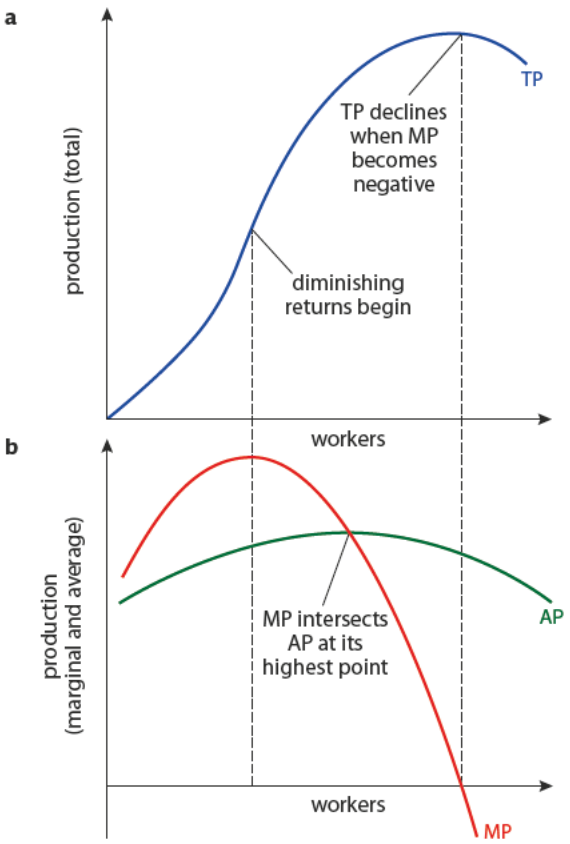


Figure 7.3
Total, average and marginal product relationships in the short run.

To learn more about the law of diminishing returns, visit www.pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 7.2.

The dotted line on the left indicates the point at which the MP of new workers stops increasing and begins to decline. On the TP curve, this is called the point of inflection, where the slope of the curve changes (prior to levelling out) as MP falls. The dotted line on the right indicates the point at which TP begins to decrease because the MP of labour has become negative. A firm employing workers beyond this point is definitely not a cost-minimizer and should lay off workers until MP becomes positive and TP increases again.

To access Worksheet 7.2 on the law of diminishing returns, please visit www.pearsonbacconline.com and follow the onscreen instructions.

7.3 From short-run productivity to long-run costs of production

Learning outcomes

- Calculate total fixed costs, total variable costs, total costs, average fixed costs, average total costs and marginal costs from a set of data and/or drawings.
- Distinguish between increasing returns to scale, decreasing returns to scale and constant returns to scale.
- Outline the relationship between short-run average costs and long-run average costs.
- Explain, using a diagram, the reason for the shape of the long-run average total cost curve.
- Describe factors giving rise to economies of scale, including specialization, efficiency, marketing and indivisibilities.
- Describe factors giving rise to diseconomies of scale, including problems of coordination and communication.

So: a firm's short-run costs of production are determined by the productivity of its short-run variable resources, most importantly labour. When worker productivity rises, the firm's per-unit costs of production fall. More-productive workers mean fewer inputs to produce a certain amount of output or more output with a certain number of workers. Less-productive workers mean firms must employ more inputs to produce a certain amount of output or that a certain number of workers will produce less output; either way the firm's per-unit costs of production rise with falling productivity and fall with rising productivity. A firm's short-run costs of production and labour productivity are therefore inversely related.

In the short-run cost table below (Table 7.3), assume the firm employs labour, land and capital to produce its output, a popular toy called the robotron. In the short run, labour is the only variable resource and therefore the total variable cost represents the wages paid to the firm's workers. The total fixed cost of $100 represents the interest the firm pays for the use of its capital and the rent it pays for the use of the factory space in which it produces robotrons.

In order to increase its output in the short run, the firm must hire additional workers. Assume the wage rate is $5 per worker, so as the firm hires more workers its total variable cost increases. Fixed costs, on the other hand, remain at $100 since the quantity of land and capital does not change in the short run (the fixed-plant period).

TABLE 7.3 SHORT-RUN COSTS OF PRODUCING ROBOTRONS

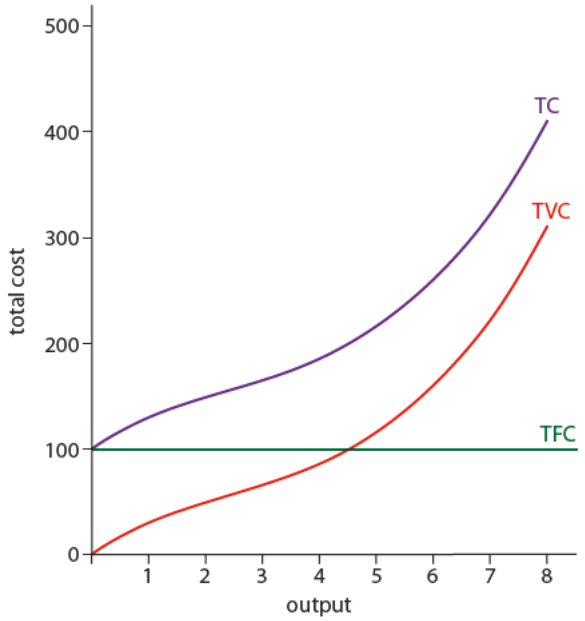
Total output per hour (Q)	Number of workers (Q_L)	Total fixed cost (TFC)	Total variable cost (TVC)	Total cost (TC = TFC + TVC)	Average fixed cost (AFC = TFC ÷ Q)	Average variable cost (AVC = TVC ÷ Q)	Average total cost (ATC = TC ÷ Q)	Marginal cost (MC = ΔTC ÷ ΔQ)
0	0	100	0	100	–	–	–	–
1	6	100	30		100	30	130	30
2	10	100		150	50		75	
3	13	100	65	165		21.7		
4	17	100	85			21.3	46.3	20
5	23	100		215	20		43	30
6	32	100		260	16.7		43.4	
7	44	100	220	320	14.3	31.4		60
8	62	100	310			38.8		90

HL EXERCISES	
	Use Table 7.3 to answer the following questions.
5	Complete the table by filling in the empty cells.
6	Why does total variable cost increase as output increases in the short run?
7	Why does total fixed cost remain constant regardless of the level of output?
8	Explain the relationship between total cost, total variable cost and total fixed cost.
9	Which column tells us the per-unit cost of robotrons at each level of output?
10	What is the relationship between the marginal cost and the total cost?
11	How do the Q and Q_L columns demonstrate the law of diminishing returns?

Total costs: fixed and variable

Figure 7.4 shows the graphical representations of the total cost data in Table 7.3.

Figure 7.4
Total costs in the short run.



First, let's examine some the relationships between the total fixed cost (TFC), total variable cost (TVC) and total cost (TC) curves.

- When output is zero, the firm's TC equals its TFC. When producing zero output, the firm does not need to employ any workers, so TVC equals zero. However, the firm must pay its interest on capital and rent on land regardless of its level of output, so fixed costs must be covered whether output is zero units, five, eight, or more.
- As the firm begins to produce output, it must hire workers. This causes its TVC to increase. The rate at which TVC increases varies with the changing productivity of labour, reflected by the S shape of the TVC curve.
- TFC remains at $100 in the short run because the firm is not increasing its land and capital inputs, only its labour.
- TC increases at the same rate as TVC and is a parallel line $100 above TVC. At each level of output, the firm's TC equals the sum of its TFC and its TVC:

$$TC = TFC + TVC$$

The shapes of the TC and TVC curves are important. Notice that while TC and TVC increase as output increases, the slopes vary across the range of output. At first, between

one and three units of output, the slopes of TC and TVC become flatter and flatter, but beyond three units, the curves become steeper and steeper. This is because as workers are hired, the marginal returns on labour at first increase as existing capital is used more efficiently. Then, beyond a certain point, the marginal returns on labour begin to diminish as more and more labour is added to a fixed amount of capital.

TVC increases at a decreasing rate while marginal returns to labour are increasing, and at an increasing rate while labour experiences diminishing marginal returns. A firm's TVC curve is therefore the mirror image of its total product curve.

As can be seen in Figure 7.5, the shapes of and relationship between a firm's total productivity (TP) and its TVC reflect the law of diminishing marginal returns and the two curves therefore display an inverse relationship. Over the range of increasing marginal returns, TP increases at an increasing rate and TVC increases at a decreasing rate because output rises with each additional unit of input. Beyond the dotted line, TP increases at a decreasing rate and TVC at an increasing rate, since each additional worker adds less and less to the firm's output.

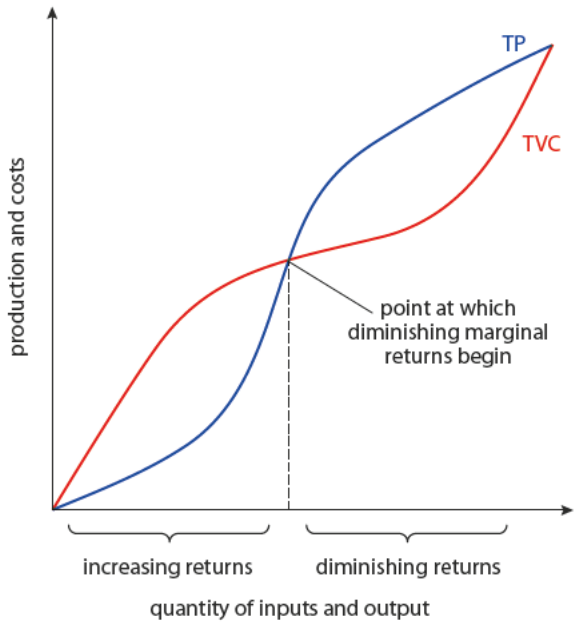


Figure 7.5
Total product and total variable cost.

Per-unit costs: average and marginal costs

Figure 7.6 shows the average variable cost (AVC), average fixed cost (AFC), average total cost (ATC) and marginal costs (MC) for the robotron producer.

Let's consider some important observations about the average and marginal cost curves.

- AFC decreases as output increases. Since TFC is constant at $100, AFC continually decreases at higher levels of output. This fall in AFC at higher level of output is known as 'spreading the overhead'.
- MC decreases and then increases as output increases. From one to three units, MC falls because of increasing marginal returns to labour. Beyond three units, MC

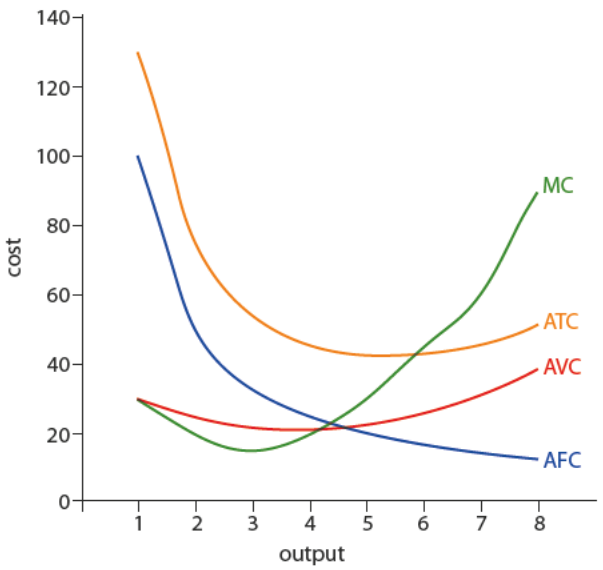


Figure 7.6
Average variable, average fixed, average total and marginal costs in the short run.

increases due to the law of diminishing returns and the declining productivity of labour as it is added to a fixed amount of land and capital. The increase in MC corresponds with the increase in slope of total cost.

- ATC lies above AVC. Just as a firm's TC is equal to the sum of its variable and fixed costs, the firm's ATC is equal to the sum of its AVC and AFC. At any level of output, the distance between the ATC curve and the AVC curve equals the firm's AFC.
- MC intersects ATC and AVC at their lowest points. The same relationship that held for marginal product (MP) and average product (AP) holds for MC and AC. If the last unit produced costs the firm less than the average per-unit cost then the average cost falls. If the last unit produced costs more than the average cost, then the average rises.

AVC, AFC, ATC and MC can be found using the following formulas.

$$AVC = \frac{TVC}{Q}$$

$$AFC = \frac{TFC}{Q}$$

$$ATC = AFC + AVC$$

$$MC = \frac{\Delta TC}{\Delta Q}$$

Figure 7.7 shows a firm's short-run per-unit costs of production.

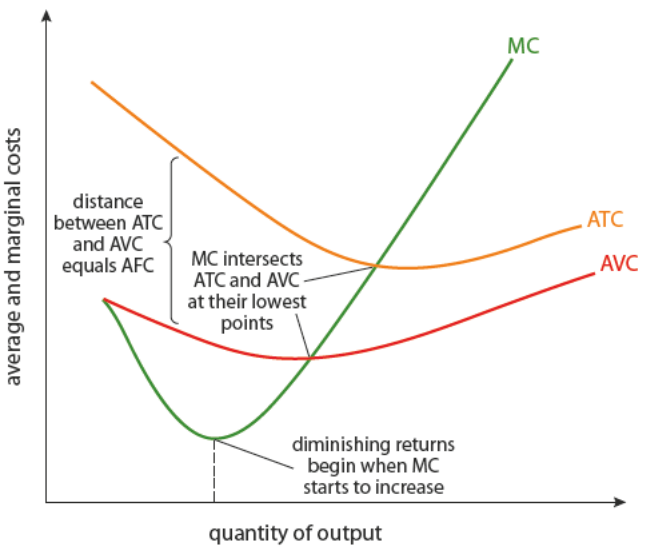


Figure 7.7
Short run costs of production relationships.

You will notice that AFC is not shown in Figure 7.7. It is not necessary to show AFC separately because its presence is inferred from the distance between ATC and AVC at any level of output. Several important characteristics of a firm's short-run cost curves are noted on the graph.

The shapes and relationships between the three curves above are very important. A firm that alters its output in the short run (fixed-plant period) faces costs similar to those shown in Figure 7.7. In deciding at which level it should produce in order to maximize its profits in the short run, a firm must take its marginal and average costs into consideration, because its total profits equal its total revenues minus its total costs (page 149). Another way to state this is in terms of per-unit profits:

average profit (profit per unit of output) = average revenue – average total cost

Later, you will learn the rule to produce at the profit maximizing level of output.

Costs of production in the long run

By the late 1930s, the first Krispy Kreme doughnut shop in North Carolina had reached its full capacity of production and the company had to make a decision: stay small and make our customers at our one shop as happy as possible, or expand and meet the demands of new customers all over the US? Of course, opening a second or third doughnut shop would not immediately allow Krispy Kreme to serve customers all over the country, but beginning in the late 1930s, the firm did begin to expand its operations around the American South, and now, nearly 80 years later, the firm operates in thousands of locations in over a dozen countries.

To access Worksheet 7.3 on costs of production, please visit www.pearsonbacconline.com and follow the onscreen instructions.

To access Worksheet 7.4 on economies of scale, please visit www.pearsonbacconline.com and follow the onscreen instructions.

Economies of scale and diseconomies of scale

As Krispy Kreme's operations expanded from the short run to the long run, it was able to open more locations, thus adding more capital, land and labour to its production of delicious, glazed, doughy rings. The long run in economics, it should be remembered, is defined as the variable-plant period. In the long run, a firm may vary all of its factors of production. The law of diminishing marginal returns no longer applies in the long run since the quantity of capital workers have at their disposal is no longer fixed. To understand how a firm's costs change in the long run, we must examine with new eyes the ATC curve (Figure 7.8).

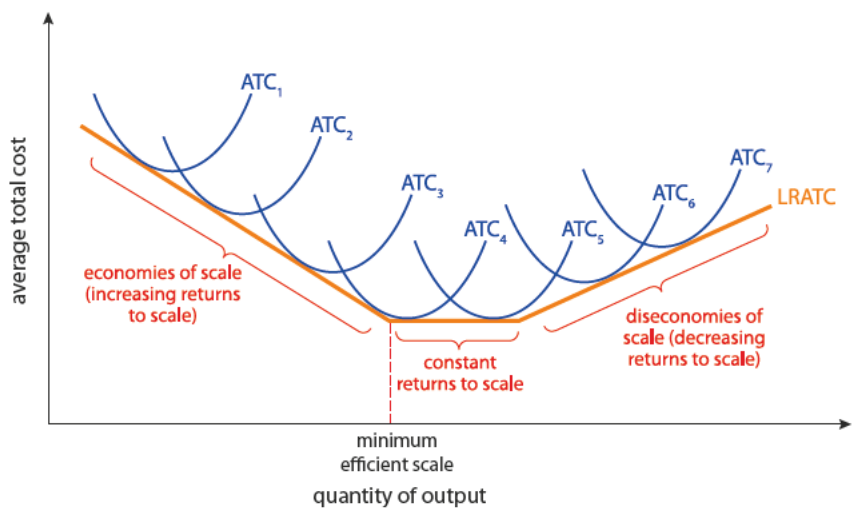


Figure 7.8
Long-run average total cost (LRATC) – consisting of several short-run periods over which a firm can open or shut plants.

To understand a firm's long-run costs of production, it helps to imagine the long run as a period of time over which a firm can open several new plants. (The term 'plant' may refer to factories, offices, shops, etc. depending on the type of firm in question.) The long-run variable-plant period is, therefore, made up of several short-run, fixed-plant periods.

Figure 7.8 shows our firm producing robotrons expanding to a level of output that is far beyond what it could have achieved with only one factory. ATC_1 shows the firm's average total costs if it operates only one factory. As you can see, beyond a certain level of output, diminishing returns would cause the single factory's average costs to rise rapidly, making it worthwhile for the firm to open a second factory, represented by ATC_2, in order to keep its costs low. Notice, however, that when it opens the second factory, the entire ATC_2 curve is at a lower average cost of production than when the firm operated only one plant. The same reduction in average costs occurs when the firm opens its third (ATC_3) and fourth (ATC_4) robotron factories.

Economies of scale help us understand why certain products produced and sold by global corporations are cheap and ubiquitous in our world. Nike trainers are inexpensive because of Nike's economies of scale. iPhones are relatively inexpensive because Apple has achieved economies of scale. Even airplanes are built at relatively low average cost because Boeing and Airbus achieve economies of scale.

There are examples throughout history of empires experiencing diseconomies of scale: the Romans and the Mongols are just two. 'The sun never sets on the British Empire' was a popular saying about the vastness of the colonies under British control. How might getting so big create challenges that may lead to the collapse of extremely large organizations such as General Motors or the Mongol Empire?

The falling ATC that occurs in the long run as the firm opens its second, third and fourth factories is attributable to an economic concept known as economies of scale. Scale is another word for size, and 'economies' in this case refers to specific benefits enjoyed by large firms that smaller businesses cannot access. The robotron firm in Figure 7.8 enjoys lower average costs of production up to opening its fourth factory. Economies of scale may include such factors as the following.

- Better prices for raw materials such as plastic and rubber parts for the robotrons due to larger bulk orders made by the firm as it grows.
- Lower costs due to higher quality and more technologically advanced machinery operating in larger factories.
- Lower average shipping and transportation costs as the firm produces and ships larger quantities of toys to the market when operating four factories than when operating only one.
- More favourable interest rates from banks for new capital as the firm becomes larger and therefore more credit-worthy.
- More bargaining power with labour unions for lower wages as the firm employs larger numbers of factory workers.
- Improved manufacturing techniques and more highly specialized labour, capital and managerial expertise.

Increasing returns to scale means that an increase in inputs leads to a larger proportional increase in output. For example, if a firm doubles the number of workers and capital and its output triples, the firm is experiencing increasing returns to scale.

The basic idea behind the concept of economies of scale is that the larger a firm becomes, the cheaper it is to produce one unit of output because of the cost advantages that a firm experiences as it expands. Throughout the range of long-run ATC over which the firm enjoys economies of scale, it experiences increasing returns to scale. This means that each additional unit of input produces increasing amounts of output.

At a certain point, further reductions in average cost become difficult or impossible, and a firm eventually achieves minimum efficient scale (MES). MES is the size at which a firm achieves its lowest possible per-unit cost of production. Beyond this size, no further cost advantages accrue as the firm continues to expand.

Constant returns to scale occur when an increase in inputs leads to a proportionally identical increase in output. For instance, if a firm adds 20% more capital, land and labour to its production and output increases by 20%, the firm is experiencing constant returns to scale. Graphically, this is the range of output over which ATC does not change with the level of output.

Over the range of output during which ATC remains constant, the firm experiences constant returns to scale – that is, a particular increase in inputs leads to a proportionally identical increase in output.

It is possible for a firm to become 'too big for its own good'. This may occur if a very large firm begins experiencing inefficiencies that cause its average costs to rise as the firm grows. This may seem counter-intuitive, as conventional wisdom would suggest that the larger a firm becomes, the better it gets at producing its output and the lower its ATC should be. However, several examples exist in the real world of firms that have experienced diseconomies of scale that have led to rising average costs and decreased competitiveness as the firms have grown larger and larger.

Long before it sought a bailout from the US government in 2008, America's largest automobile manufacturer, General Motors, struggled with the challenges related to its massive size, which actually made the firm less competitive in the auto market. Diseconomies of scale may include the following.

Decreasing returns to scale means that an increase in the quantity of inputs leads to a proportionally smaller increase in the quantity of output. A firm of this size may be 'too big for its own good'.

- Communication inefficiencies – a firm with multiple levels of management located around the world may experience increasing costs associated with communication across divisions and plant facilities. As a result, many processes may be unnecessarily duplicated throughout the company, adding to the firm's costs of production but not to its revenues.
- Office politics – managers in a mega-corporation may focus more on achieving their personal goals than on promoting the best interest of the firm itself. To this end, managers

may promote incompetent or inefficient workers in order to make themselves look better and to increase their own chances of earning a promotion to the higher ranks.

- Increased regulation – the larger a firm gets, the more likely it is to be regulated by government agencies. A firm that grows to become a dominant market force may face anti-monopoly regulations that add to the costs of production, or may be subject to anti-competitive lawsuits that lead to significant legal costs. An example here is Microsoft, which has faced several government lawsuits relating to its alleged anti-competitive behaviour.

A firm facing diseconomies of scale may be forced to deal with its rising costs by breaking up into multiple smaller firms to compete at a smaller scale against one another. Over the years, General Motors has been forced to sell or shut down several of its divisions to keep its costs down and remain competitive in the auto industry: in the early 1990s, the company shut down 21 plants and, in 2004, it folded one of its major brands, Oldsmobile.

You have now learned how a firm's costs of production are influenced by the law of diminishing marginal returns (which determines a firm's short-run costs of production) and by economies and diseconomies of scale (which explain the shape of the long-run ATC curve). However, we are not yet in a position to understand how firms can achieve their economic objective of profit maximization. A firm's total profit is a function of both its total cost and its total revenue. Thus, we must now examine what determines a firm's revenues.

To learn more about economies of scale, visit www.pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 7.3.

Economies of scale are the cost-reducing advantages that allow a firm to produce at ATC as it expands its production in the long run, adding new labour, land and capital.

Diseconomies of scale are the factors that cause a firm to experience rising ATC as it grows in size. If a firm adds a factory and ATC rises across all its factories, it is experiencing diseconomies of scale.

Minimum efficient scale (MES) is the size a firm must achieve in order to produce its output at the lowest possible per-unit (or average) total cost. Before this level of output, the firm experiences increasing returns to scale; beyond, returns to scale are constant or decreasing.

7.4 Revenues: total, average and marginal revenue

Learning outcomes

- Distinguish between total revenue, average revenue and marginal revenue.
- Illustrate, using diagrams, the relationship between total revenue, average revenue and marginal revenue.
- Calculate total revenue, average revenue and marginal revenue from a set of data and/or diagrams.

Revenue is the income a firm receives from the sale of its output. Whether producing petroleum, doughnuts or children's toys, a firm will always attempt to maximize the difference between its total revenues and its total costs in order to earn the greatest amount of profit possible. Most firms seek to maximize profit, not revenue. To understand how they do this, we must look at how a firm's revenues are earned and how they change as the quantity of output changes.

Let's examine the revenue tables for two different types of firm: a perfectly competitive firm and an imperfectly competitive firm.

Revenues for a perfectly competitive firm

You will recall from Chapter 2 (page 23) that a perfectly competitive firm is one that competes in a market with a very large number of firms each producing an identical product, and each firm's output making up a tiny fraction of the total market supply. This makes it impossible for a single firm to affect the market price by increasing or decreasing

its output unilaterally. Firms in perfectly competitive markets are known as price-takers. The price at which such a firm sells its output remains unchanged regardless of the firm's output.

Table 7.4 shows the revenues for a perfectly competitive firm – the robotron manufacturer – assuming the market price of robotrons is $50.

TABLE 7.4 REVENUES FOR A PERFECT COMPETITOR

Quantity of output (Q)	Price (P) = average revenue (AR) = marginal revenue (MR) / $	Total revenue (TR) / $
1	50	50
2	50	100
3	50	150
4	50	200
5	50	250
6	50	300
7	50	350
8	50	400

Notice that the price of $50 also equals the firm's average revenue (AR) and its marginal revenue (MR). The definitions of AR and MR explain why this is the case. AR is the revenue per unit of output, which is the price at which each unit is sold. MR is the amount by which total revenue (TR) changes with each additional unit of output sold, which again is the price at which each unit is sold. AR is equal to the price (*P*), which in the case of a price-taking perfect competitor, is equal to MR, since the firm will always sell additional units of output for the market price.

$$TR = P \times Q$$

$$AR = \frac{TR}{Q}$$

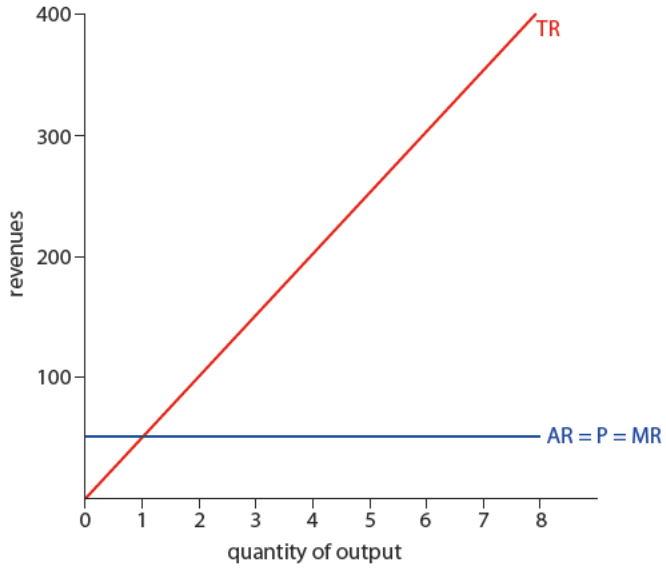
$$MR = \frac{\Delta TR}{\Delta Q}$$

$$MR = AR = P$$

TR is equal to the price times the quantity of output sold. Since the price is constant at all levels of output, the firm's TR increases at a constant rate as it produces and sells greater quantities of output. Therefore, MR equals *P* and AR.

Graphically, the TR curve is an upward-sloping line with a constant slope equal to the price (Figure 7.9). MR and AR are the horizontal line equal to the price of the firm's output, which itself is determined in the market for robotrons, in which this firm is only one of hundreds of identical competitors.

Figure 7.9
Total, average and marginal revenue for a perfectly competitive firm.



Determining the MR and AR for a perfectly competitive firm is easy once you know the market price of the output. Market price, of course, is determined not by each individual firm, but in the market itself. Figure 7.10 represents the market for robotrons, which includes 1000 identical firms, and the revenue data for an individual robotron producer.

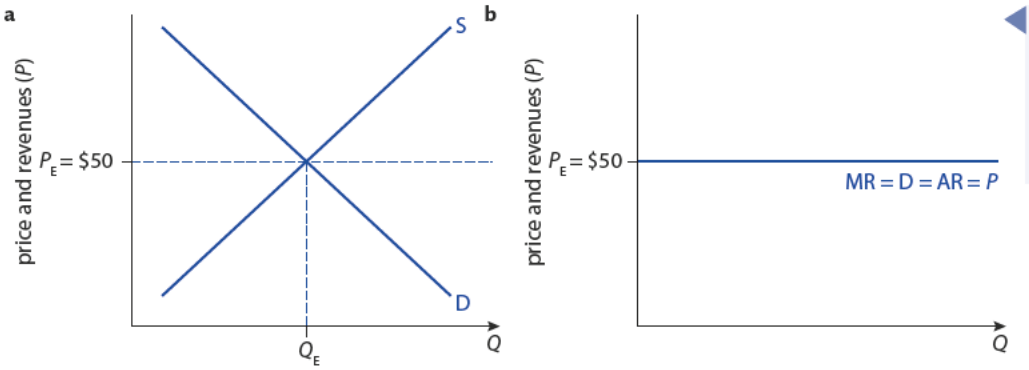


Figure 7.10
a A perfectly competitive market; **b** a single firm in the market, for which demand is determined by the market equilibrium price.

The price of robotrons, P_E, is determined by the market supply and the market demand for the toy. Supply in the market represents the total output of 1000 robotron producers and how those firms respond to a change in the price. Demand represents responsiveness of robotron consumers to changes in the price. The intersection of market demand and market supply determines the equilibrium price of robotrons.

In Figure 7.10b, the price of $50, established by the market, is used to derive an individual robotron producer's MR and AR curve and to represent the demand for an individual firm's output. Notice that when viewed as a demand curve, the MR = AR = *P* line is perfectly elastic at the market price of $50.

A price taker faces perfectly elastic demand from its consumers for a very simple reason: it is one of hundreds of firms selling an identical product, all charging the same price. If a single firm should lower its price even by a few cents the quantity demanded by the market would increase dramatically. In fact, every rational consumer aware of this price decrease would wish to buy robotrons from the one firm charging a price lower than market equilibrium. On the other hand, if one firm raises its price at all, rational consumers will demand zero output from that firm since there are hundreds of others selling the same product at the lower equilibrium price.

The responsiveness of consumers to changes in the price of an individual firm in a perfectly competitive market is perfectly elastic. Demand as seen by the perfectly competitive firm is, therefore, horizontal at the equilibrium price established by the market.

● Examiner's hint

A trick to remember what to label the demand curve in a perfectly competitive firm's diagram is to give the horizontal line a name. Demand is actually known as Mr Darp. Mr Darp is a useful way to remember how to label demand for a perfectly competitive firm, because the name is made up of the four identities of this curve: MR = D = AR = P.

Revenues for an imperfectly competitive firm

In Chapter 2 (page 23), you met the four market structures:

- perfect competition
- monopolistic competition
- oligopoly
- monopoly.

The latter three of these are considered imperfectly competitive, and firms within such markets share certain important characteristics that affect their revenues.

- There are fewer firms in imperfectly competitive markets than in perfectly competitive markets, which means that a change in the output of an individual firm will have at least some effect on the market price of its output.
- Firms in imperfectly competitive markets differentiate their products from one another. This adds to their price-making power. A firm with a unique product can raise its price without fear of losing all its customers, as would happen if a perfect competitor raised its price.

- Imperfect competitors are price-makers, which means that in order to sell additional units of output, such a firm must lower the price it charges consumers.

An imperfectly competitive firm, regardless of whether it's in a monopolistically competitive market or is a pure monopoly, faces a downward-sloping demand curve, as opposed to the perfectly elastic demand curve faced by perfect competitors. Table 7.5 shows the demand schedule, and the TR, AR and MR of a purely monopolistic robotron producer.

TABLE 7.5 REVENUES FOR AN IMPERFECT COMPETITOR

Quantity of output (Q)	Price (P) = average revenue (AR)	Total revenue (TR)	Marginal revenue (MR)
0	450	0	-
1	400	400	400
2	350	700	300
3	300	900	200
4	250	1000	100
5	200	1000	0
6	150	900	-100
7	100	700	-200
8	50	400	-300

Unlike the purely competitive robotron producer, the monopolist must lower the price it charges for its output in order to sell greater quantities. There are no longer hundreds of identical firms for customers to choose from, so consumers are less responsive to higher prices, thus the quantity demanded does not immediately fall to zero when the firm raises its price, nor does every consumer in the market wish to buy from this firm when its price decreases. There is an inverse relationship between the price the imperfect competitor charges and the quantity demanded of its output.

Additionally, unlike the perfect competitor, the monopolist's MR is no longer equal to its price and AR. You will recall that MR measures the change in the firm's TR when it increases its output by one unit. Since a perfect competitor can sell all of its output for the market price, the MR equals the price at all levels of output. An imperfect competitor, however, must lower the price of all of its output to increase the quantity it sells to consumers. When it does so, it must accept a lower price for the additional unit it sells, and for *all* of its output (assuming the firm does not price discriminate, which is discussed in Chapter 9).

Table 7.6 shows what happens to TR, AR and MR when this firm increases its output from three to four robotrons.

TABLE 7.6 AS PRICE FALLS, MR FALLS MORE QUICKLY FOR AN IMPERFECT COMPETITOR

Q	P = AR	TR	MR
3	300	900	200
4	250	1000	100

The marginal revenue of the fourth unit ($100) is less than the price it sold the fourth unit for ($250). Since the firm is a single-price seller, meaning all customers will pay the same price as all others, the firm must sacrifice some of the revenue it was earning by selling three units at a price of $300 in order to sell four units at the price of $250. The marginal revenue is not, therefore simply the price of the fourth unit, since in order to sell

the additional unit, the firm had to accept $50 less for the three units it could have sold at a price of $300. While the AR at four units is $250, the MR must account for the lost revenue (3 × $50) the firm experiences when it lowers its price to $250 to sell the fourth unit. Therefore, MR is $250 (the price at which four units are sold) minus $150 (the revenue sacrificed when lowering the price to sell one more unit), equalling $100.

All this is a complicated way of saying that a single-price monopolistically competitive, oligopolistic or monopolistic firm must lower the price of all of its output in order to sell an additional unit, hence its MR declines faster than its AR and price. Only for the first unit of output will price, AR and MR be the same (Table 7.5).

Graphically, the TR, AR and MR curves for the robotron producer discussed above will look like Figure 7.11.

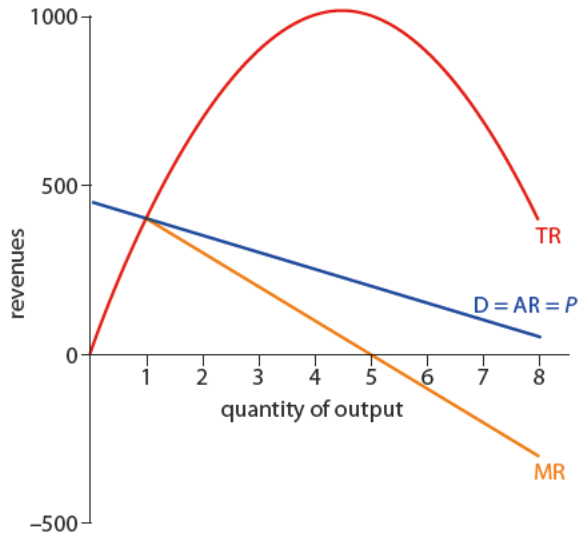


Figure 7.11
Total, average and marginal revenue for an imperfect competitor.

TR is maximized when MR = 0

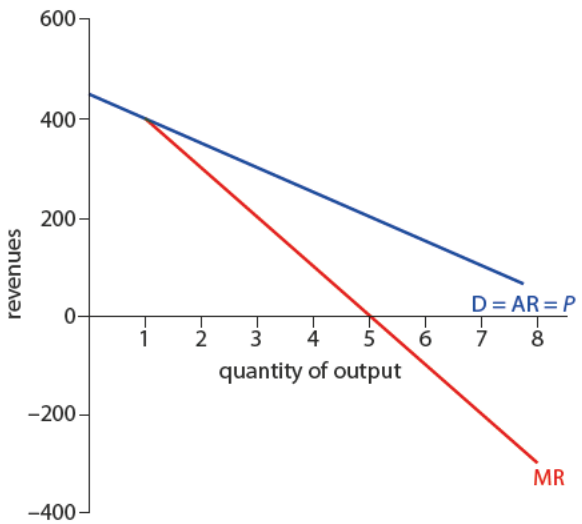
The relationship between TR and MR reflects the same relationship described between TP and MP and costs (page 154). MR is given by the slope of TR, since marginal revenue measures the rate of change in total revenue.

As long as MR is positive, TR will increase. Since MR decreases as output increases, the slope of the TR curve levels out until MR equals zero, at which point the firm's TR is maximized. When MR falls below zero, the firm's TR begins to decrease. If the robotron producer above were producing beyond five units, it would certainly do better by decreasing its output, which would increase its TR while lowering its total costs, thus increasing the firm's profits.

Let's take a closer look at the relationship between marginal revenue and the D = AR = *P* line. Figure 7.12 shows demand, AR and MR for an imperfect competitor.

The blue curve in Figure 7.12 represents this firm's AR and price, and also demand as seen by the firm. The imperfect competitor is a differentiating price-maker facing a downward-sloping demand curve. The AR = *P* line is also the firm's demand curve. We no longer have a single MR = D = AR = *P*

Figure 7.12
Demand, average revenue and marginal revenue for an imperfect competitor.



line, because the MR curve lies below the D = AR = *P* line at every level of output beyond one unit. The slope of a single-price imperfectly competitive firm's MR curve will be twice that of its demand curve, since MR falls at a greater rate than price because the firm must lower all of its prices in order to sell more output.

HL EXERCISES

Use Figure 7.12 to answer the following questions.

12 Identify the revenue-maximizing level of output for the monopolistic firm represented.

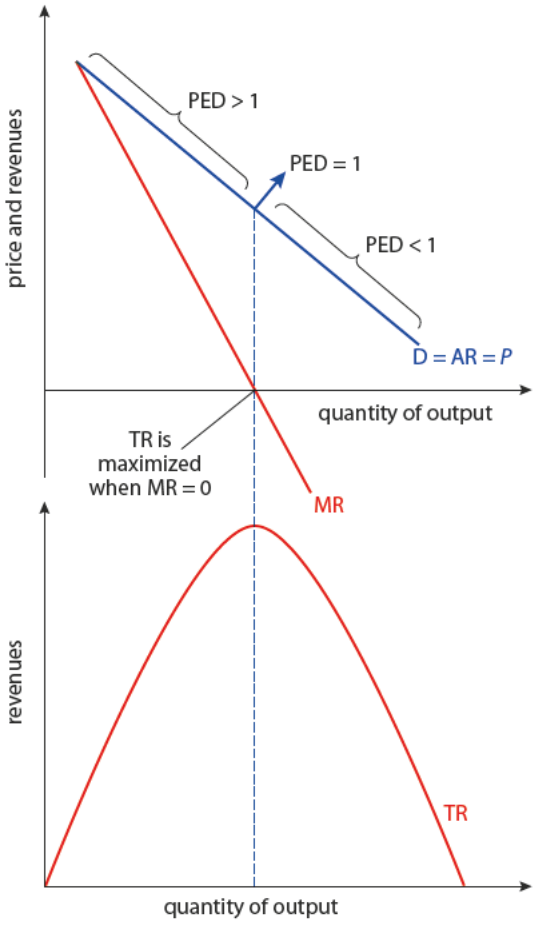
13 Explain why the firm's marginal revenue curve is equal to the price at an output of one unit, but is less than price at every quantity beyond one.

14 Why would the firm never wish to produce a level of output beyond five units?

The total revenue test revisited

You may recall from Chapter 4 (page 81) that one way to determine whether demand is elastic or inelastic is to determine how TR changes following a change in price. The total revenue test tells us that if a fall in price leads to an increase in TR, demand is elastic, but that if TR falls following a price decrease, demand is inelastic. Figure 7.13 applies the total revenue test for elasticity to an imperfectly competitive firm's demand, MR and TR curves.

Figure 7.13
The relationship between demand, MR and TR for an imperfect competitor.



An imperfect competitor will never wish to produce at a point beyond the unit elastic point (PED = 1) on its demand curve, and for a very good reason. As the firm increases its

output beyond this point, its total costs continue to rise, but as you can see above, its total revenue decreases. Recall that profit equals total revenue minus total cost. An increase in TC accompanied by a fall in TR will definitely lead to a decline in a firm's profits, thus we know that a profit-maximizing firm will never produce in the inelastic range of its demand curve.

To learn more about cost minimization, visit www.pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 7.4.

7.5 The short-run profit-maximization rule

Learning outcomes

- Describe economic profit as the case where total revenue exceeds economic cost.
- Describe normal profit as the amount of revenue needed to cover the costs of employing self-owned resources (implicit costs, including entrepreneurship) or the amount of revenue needed to just keep the firm in business.
- Explain that economic profit is profit over and above normal profit, and that the firm earns normal profit when economic profit is zero.
- Explain why a firm will continue to operate even when it earns zero economic profit.
- Explain the meaning of loss as negative economic profit arising when total revenue is less than total cost.
- Calculate different profit levels from a set of data and/or diagrams.
- Explain the goal of profit maximization where the difference between total revenue and total cost is maximized or where marginal revenue equals marginal cost.

Why did BP begin drilling for oil in the Gulf of Mexico? Why did Krispy Kreme start making doughnuts in North Carolina? And why did our imaginary robotron companies start making children's toys? One goal of any entrepreneur who embarks on a new business venture is undoubtedly to earn a profit beyond his or her costs, both explicit and implicit.

We have identified these costs, including wages for labour, interest for capital, rent for land and what we defined as normal profit for the entrepreneur. Normal profit is a cost to firms since an entrepreneur who does not earn this base level of profit will shut the business down and seek to employ his or her self-owned resources in a market in which the possibility for greater profits exist.

An economic profit is earned when a firm's total revenues exceed all its explicit and implicit costs of production, including a normal profit. Economic profits are greater than normal profits, and are, therefore, sometimes referred to as abnormal profits or supernormal profits.

Economic profits occur when a firm earns revenues in excess of all of its costs, both explicit and implicit, including a normal profit for the entrepreneur. Economic profits are, therefore, also known as supernormal or abnormal profits, since they are above and beyond the normal profit required to keep the firm in operation.

Any business manager must decide in the production process just how much output to produce in order to maximize the firm's profits, or in a less desirable scenario, minimize its losses. The profit-maximization rule of output helps firms decide just what this golden level of output is.

The total revenue/total cost approach

We know that total profits are found by subtracting TC from TR, so one way a producer can maximize profits is by producing at the quantity where the difference between TR and TC is the greatest. When we combine the revenue and cost data for our perfectly competitive robotron producer, we can determine at what level of output the profits are maximized (Table 7.7, overleaf).

TABLE 7.7 TOTAL REVENUES AND COSTS FOR A PERFECT COMPETITOR				
Total output (*Q*)	**Price (perfect competitor) (*P*)**	**Total revenue (TR)**	**Total cost (TC)**	**Total profit = TR – TC**
0	50	0	100	–100
1	50	50	130	–80
2	50	100	150	–50
3	50	150	165	–15
4	50	200	185	15
5	50	250	215	35
6	50	300	260	40
7	50	350	320	30
8	50	400	410	10

At six units of output, the difference between the firm's TR and TC is maximized. Graphically, this is the quantity at which the distance between the TR and TC curve is maximized (Figure 7.14).

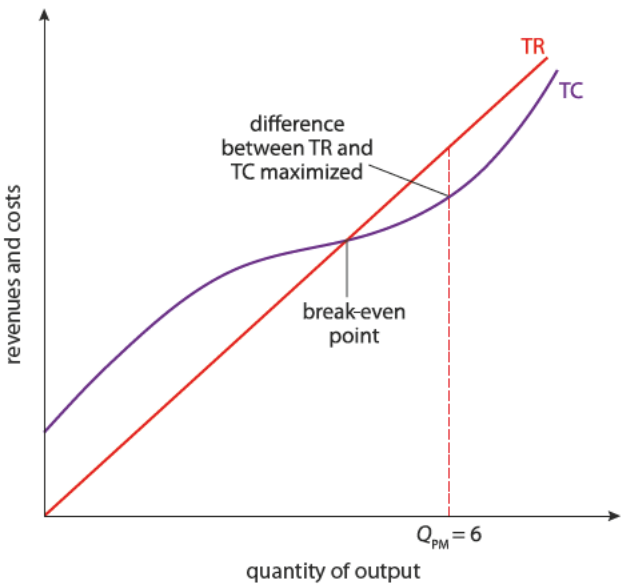


Figure 7.14
Total revenue and total cost approach to profit maximization for a perfectly competitive firm.

Figure 7.14 shows the TR and TC curves of a perfectly competitive firm in order to determine the quantity of output at which the difference between TR and TC is maximized and its economic profits are maximized, in this case at six units of output. Of course, the firm wants to produce at a quantity at which TR is greater than TC so that its economic profits are positive. At the break-even point, the firm is covering all its economic costs and earning a normal profit, but it is not earning any economic profits. At any point below the break-even point, the firm is earning economic losses since its total costs exceed its total revenues.

An imperfectly competitive firm trying to maximize profits should choose a level of output following the same approach as the perfect competitor, producing where the difference between the TR and TC curves is maximized. Table 7.8 combines the revenue and cost data for our imperfect competitor robotron producer.

TABLE 7.8 TOTAL REVENUE AND TOTAL COST FOR AN IMPERFECT COMPETITOR				
Total output (*Q*)	**Price (imperfect competitor) (*P*)**	**Total revenue (TR)**	**Total cost (TC)**	**Total profit = TR – TC**
0	450	0	100	–100
1	400	400	130	270
2	350	700	150	550
3	300	900	165	735
4	250	1000	185	815
5	200	1000	215	785
6	150	900	260	640
7	100	700	320	380
8	50	400	410	–10

Figure 7.15 shows a price-making, imperfectly competitive firm's TR and TC curves and the level of output at which the distance between the two is maximized.

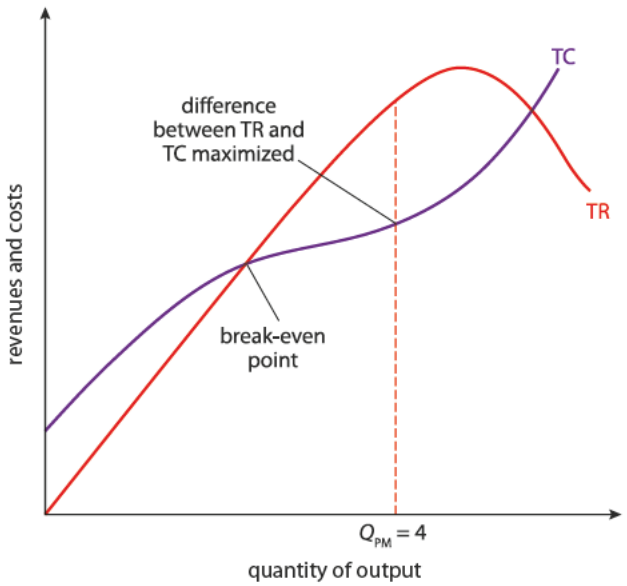


Figure 7.15
Total revenue and total cost approach to profit maximization for an imperfect competitor.

While the TR/TC approach can be used to determine the level of output at which firms should produce to maximize their economic profits, a more common approach requires firms to examine their MR and MC.

The marginal revenue/marginal cost approach

Firms, like individuals, think on the margin. In economics, marginal thinking is a key characteristic of self-interested, utility-maximizing individuals and firms. Consumers think on the margin when they decide whether the marginal benefit of a decision or a purchase is greater than or less than the marginal cost. For instance, if the benefit of one more ride on a roller coaster at an amusement park outweighs the few dollars it costs, then you take that additional ride.

Likewise, a firm weighs the benefits and costs of additional units of output when deciding at what level of output it should stop producing more units. For a firm, however, it is not marginal utility that is weighed against marginal cost, it's marginal revenue. If

The profit-maximization rule of production states that to maximize its total profits, a firm in any market structure should produce as close as possible to the point at which its marginal revenue equals its marginal cost of production, where MR = MC.

the additional revenue a firm earns by producing one more unit of output exceeds the marginal cost of production, then it is always in the profit-maximizing firm's interest to produce additional units. However, if one more unit of output costs more than the revenue it brings in, then it should not be produced.

At what level should a firm target its production in order to maximize economic profits? It should follow the marginal revenue/marginal cost rule of profit maximization, which states that in order to maximize its total economic profit, a firm should produce up to the level of output at which its marginal revenue equals its marginal cost.

Table 7.9 shows marginal cost and marginal revenue data for our perfectly competitive robotron producer.

TABLE 7.9 MARGINAL COST AND MARGINAL REVENUE FOR A PERFECT COMPETITOR

Total output (Q)	Price (perfect competitor) (P)	Total cost (TC)	Marginal cost (MC)	Total revenue (TR)	Marginal revenue (MR)
0	50	100	–	0	–
1	50	130	30	50	50
2	50	150	20	100	50
3	50	165	15	150	50
4	50	185	20	200	50
5	50	215	30	250	50
6	50	260	45	300	50
7	50	320	60	350	50
8	50	410	90	400	50

HL EXERCISES

Use Table 7.9 to answer the following questions.

15 Identify the following from the data in the table:

- **a** the profit-maximizing level of output and price
- **b** the level of economic profit earned when producing at this level of output
- **c** the level of output below which this firm would earn economic losses
- **d** the level of output beyond which the firm would earn economic losses.

16 Why does the price seen by the perfect competitor remain constant as the firm's output increases?

17 Why does the firm's marginal revenue equal its price at every level of output?

At six units of output, the marginal cost of $45 is just below the marginal revenue of $50. To maximize its profits, the firm should produce up to, but no more than, 6 robotrons. To see why six units maximizes profits, examine what happens if the firm produces less than or more than this number.

- At five units of output, the last unit produced cost the firm only $30 and earned the firm $50 of revenue. The profit on the last unit was $20.
- The sixth unit of output cost the firm $45 and earned the firm $50 of revenue. The profit on the sixth unit was only $5, less than on the fifth unit, but still positive, adding to the firm's total profits.
- The seventh robotron costs the firm $60 and only brings $50 of revenue. The firm would lose $10 on the seventh unit of output.

Clearly, at every level of output up to and including the sixth unit, this firm can earn profits on each unit produced and sold. The goal of firms is to maximize total profits, so even if the marginal cost of the sixth unit were $49.99, the firm would still wish to produce it even though the profit is only $0.01. Profits are profits, and as long as there is any profit at all to be earned, firms should produce additional output. But as soon as an additional unit costs the firm more than it can be sold for, the firm should stop producing more output and maintain its profit-maximizing level at which MR =MC.

The seventh robotron imposes a loss on this firm, so it should not be produced. Profit maximization on the margin requires a firm to produce as close as possible to the point at which it is breaking even on the margin (i.e. on the last unit of output it produces, it earns zero economic profit). At this point, the firm's total profit is maximized.

An imperfect competitor can follow the same short-run profit-maximization rule as a perfect competitor. Table 7.10 shows the costs and revenues for an imperfect competitor.

TABLE 7.10 MARGINAL COST AND MARGINAL REVENUE FOR AN IMPERFECT COMPETITOR

Total output (Q)	Price (imperfect competitor) (P)	Total cost (TC)	Marginal cost (MC)	Total revenue (TR)	Marginal revenue (MR)
0	450	100	–	0	–
1	400	130	30	400	400
2	350	150	20	700	300
3	300	165	15	900	200
4	250	185	20	1000	100
5	200	215	30	1000	0
6	150	260	45	900	–100
7	100	320	60	700	–200
8	50	410	90	400	–300

HL EXERCISES

18 Use Table 7.10 to answer the following questions.

Identify the following from the data in the table:

a the profit-maximizing level of output and price

b the level of economic profit earned by the firm at this quantity

c the revenue-maximizing level of output and price

d the level of output beyond which this firm would earn economic losses.

19 How does this firm's profit-maximizing level of output and price differ from those of the perfectly competitive firm with the same costs of production?

20 Why does the imperfect competitor's price decrease as its output increases?

21 Why does MR fall faster than price?

For the imperfectly competitive firm whose costs and revenues are shown in Table 7.10, there is no single level of output at which MR = MC. However, following the same rationale as the perfect competitor shown in Table 7.9, this firm will produce up to, but not beyond, the level at which the last unit produced cost as much as to produce as it added to the firm's revenue.

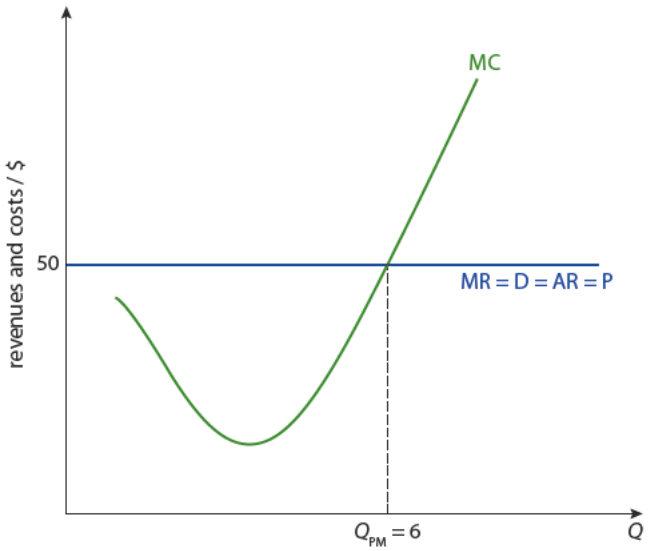
- The third unit cost the firm $15 to produce and added $200 to the firm's revenue. Clearly it was a good idea to produce the third unit.
- The fourth unit cost the firm only $20 yet added $100 of revenue. The firm earned a profit of $80 on the fourth unit.

- The fifth robotron costs this firm $30 to produce yet adds nothing to its revenues. The firm in fact loses $30 in the production and sale of the fifth unit.

Following the profit-maximization rule, this firm should produce only four units of output. Any quantity less than that and the firm is missing out on potential profits, anything beyond that and the firm is incurring unwanted economic losses.

Graphically, the MR = MC rule for profit maximization can be shown by plotting a firm's MC and MR curves on the same axes. MC and MR curves for the perfectly competitive firm in Table 7.9 are shown in Figure 7.16.

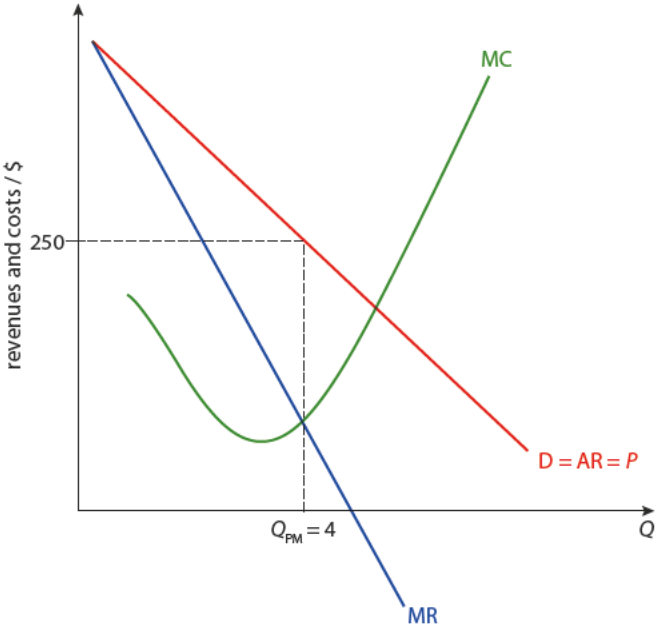
Figure 7.16
Profit-maximization rule (perfectly competitive firm): produce at the quantity at which marginal revenue equals marginal cost.



This profit-maximizing firm will produce up to, but not beyond six units of output. Anything beyond six units and the additional cost to the firm exceeds the additional revenue, incurring economic losses. Any quantity below six units and the firm is missing out on potential additional profits.

Figure 7.17 shows an imperfectly competitive firm, evidenced by the downward-sloping demand curve showing that this firm has price-making power. The MR curve lies below the demand, AR and price line. The firm will produce four units, the level of output at which the next unit produced will cost more than it adds to the firm's revenue.

Figure 7.17
Profit-maximization rule (imperfectly competitive firm): produce at the quantity at which marginal revenue equals marginal cost.



Notice that the equilibrium price in the perfectly competitive market is less than that in the single-price imperfectly competitive market. This and other characteristics of the different market structures are explained in more depth in the next few chapters. We will add average cost curves to our graphical analyses to illustrate areas of economic profit and loss and to understand how the existence of profits and losses affects different markets in the short run and the long run.

This chapter has introduced the theory of the firm and identified the various costs, both implicit and explicit, faced by firms in the short run and in the long run. Two important economic principles were introduced which explain the shapes of firms' short- and long-run cost curves, the law of diminishing returns and economies/diseconomies of scale.

You now know why BP made the decision to save $10 million in the construction of its *Deepwater Horizon* well in the Gulf of Mexico, and you also learned why Krispy Kreme chose to begin its long period of expansion from its one doughnut shop in North Carolina way back in the 1930s to its thousands of outlets around the world today. You learned why General Motors, once the largest auto manufacturer in the world, was forced to downsize in the 1990s to combat diseconomies of scale and remain competitive. Additionally, you have learned the difference between normal profit and economic profit and the two approaches firms in all market structures may take to maximize their economic profits.

In the coming chapters, you will explore in more depth the competitive behaviours and profit-maximizing decisions of firms in markets from the highly efficient, yet mostly theoretical, perfectly competitive markets to the allegedly evil empires of near monopolistic firms.

To learn more about profit maximization, visit www.pearsonhotlinks.com, enter the title or ISBN of this book and select weblink 7.5.

Evaluate the claim that the ultimate goal of all firms should be to maximize their profits. What are the moral or ethical outcomes that may result from firms pursuing maximum profits over all other possible ends?

To access Quiz 7, an interactive, multiple-choice quiz on this chapter, please visit www.pearsonbacconline.com and follow the onscreen instructions.

PRACTICE QUESTIONS

1 **a** Explain the relationship in the short run between the marginal costs of a firm and its average total costs. (10 marks) [AO2]

b Define the law of diminishing returns and assess the likelihood that it will be experienced by a firm producing a product in a consumer good market. (15 marks) [AO3]

2 **a** What are the distinctions between decreasing returns to scale and diminishing marginal returns? (10 marks) [AO2]

b Evaluate the options available to a firm experiencing decreasing returns to scale to reduce its costs and remain competitive, using an example to guide your response. (15 marks) [AO3]

3 **a** At what level of output should a firm produce to maximize its total profits? Use a diagram to help explain your response. (10 marks) [AO2], [AO4]

b 'Whatever the type of market structure, profit maximization will always be the only goal of firms.' Discuss. (15 marks) [AO3]