Chapter 3
Firms in the marketplace

Chapter contents

Learning outcomes

By the end of this chapter you should understand:

Economic Theory

LO1 The difference between the short and the long run

LO2 The difference between variable, fixed and total costs

LO3 The concepts of marginal product and marginal costs

LO4 The law of diminishing returns

LO5 Economies of scale

LO6 The concept of minimum efficient scale

Business Applications

LO7 Why low pricing and high volume sales strategies, deployed by budget airlines, reflect high fixed costs

LO8 Why qualification for the Champions' League by leading football clubs is a strategy for dealing with the high cost of owning and employing footballers

LO9 When times get tough, when to decide to quit and when to hang on for a bit

Cost theory at a glance

The issue

World-class footballers cost in excess of €40 million, and the Superjumbo A380 costs $264 million. Neither are cheap. So how does a business make money when using such expensive assets?

The understanding

Such assets represent costs that do not vary with the level of output. The way to exploit such assets is to make them productive. The more games Ronaldo plays for Real Madrid, the cheaper per game he becomes. The more flights a plane flies, the cheaper per flight the plane becomes. Unfortunately, over short periods of time, volume may come up against a problem known as the 'law of diminishing returns', while in the long run firms can encounter an additional problem known as 'diseconomies of scale'. By the end of this chapter you will understand each of these problems and how costs can be managed in the short and the long run.

The usefulness

This chapter will enable you to understand why successful airlines sell their seats at low prices, why teams such as Manchester United are desperate to stay in the Champions' League and why R&D-intensive technology products need to conquer world markets.

3.1 Business problem: managing fixed and variable costs

Fixed costs are constant. They remain the same whatever the level of output.

Variable costs change or vary with the amount of production.

Economists categorize costs as being fixed or variable.

Supermarket stores represent **fixed costs**. If the store attracts one shopper or 1000 shoppers per day, the cost of developing and maintaining the store is fixed. However, the number of checkout staff does change with the number of shoppers and, therefore, represents a **variable cost**. The cost of developing Apple's iPhone was a fixed cost. Development costs do not increase if more iPhones are sold. Rather, the cost of producing more iPhones increases. Universities are a vast collection of fixed costs. The cost of lecture theatres, lecturers, library resources, central administration units and computer facilities is not hugely influenced by the number of recruited students. For example, the cost of lecturing to 50 students is the same as lecturing to 250 students.

The nature of fixed and variable costs has enormous implications for business. As an example, consider the contrasting differences between employing burger flippers and professional footballers.

Burger flippers at fast-food restaurants are perhaps paid no more than £6 per hour. The majority of employed hours are on weekends, evenings or lunchtimes, periods when consumer demand is highest. This is because the employment of burger flippers is linked to the demand for burgers. More burger flippers are employed at lunchtimes and weekends when demand, and therefore the production of burgers, is highest. As a result, the cost of employing burger flippers is a predominantly variable cost. The wages paid rise and fall with the level of output. Ultimately, if demand for burgers drops dramatically, restaurants can generally terminate the employment of their burger flippers by giving one month's notice.

Professional footballers can be paid £150 000 a week when they play a game. This may fall by a fraction if they are on the substitutes' bench or when they are injured. Similarly, the wage may increase with bonuses if goals are scored or after a specified number of first team appearances. It is important to remember that the bulk of a professional footballer's wages is not linked directly to the creation of output, namely football games. Playing games or sitting on the subs' bench only leads to relatively small changes up or down in the wages paid to the player. The cost of employing professional footballers is, therefore, a predominantly fixed cost. A club's wages bill is changed very little by the number of games played. Furthermore, because footballers' contracts are fixed for anything up to five years, if the club wishes to terminate the employment of the player two years into the contract, it would have to pay three years' worth of compensation. These employment differences between footballers and burger flippers are crucial.

The business problem associated with employing footballers, or fixed costs, is *not* that they cost huge sums of money, but that the *nature* of the cost *does not change* with *output* and *revenues*.

If the revenues received from fans and television rights drop, clubs still have to honour their contractual obligations with their players. In contrast, fast-food restaurants can change the number of burger flippers when demand falls. The transfer of football players between clubs is both the transfer of an asset and a liability. The buying club gains what it believes is a good player, but at the same time it also commits itself to an increase in its fixed costs.

It is important for businesses to recognize the various components of their cost structures and to differentiate between fixed and variable costs. By doing so, they can then develop business models that accommodate the financial commitment associated with fixed costs. Box 3.1 clearly highlights the importance of understanding fixed costs in the cruise sector. Ships are enormous fixed costs, as is the fuel used to move them around the world. By keeping an eye on sales, the cruise operator Carnival is trying to ensure that sufficient revenue is generated to cover these enormous fixed costs. By the end of this chapter you will understand how to manage such cost structures highlighted by our initial discussion. But in order to achieve this, you need to develop a broader understanding of cost theory.

Box 3.1 Carnival's steady cruise could be about to hit choppy waters

Adapted from an article by Nick Hasell in The Times, *19 September 2008*

After two years of being clobbered by crude, oil prices are finally coming to the aid of Carnival. Shares in the world's largest cruise ship operator have rallied more than 40 per cent from their July low. Not that fuel bills are no longer a headache for Carnival. It still expects to spend $678 million more on fuel this year than it did in 2007.

More important, Carnival has left its near-term sales forecasts unchanged: advance bookings are running slightly below last year, but ticket prices have risen. Given the necessity for cruise operators to ensure that their ships sail full – because of their high fixed costs – the fact that Carnival has been able to resist cutting prices so far is a powerful sign of its confidence; especially given that the launch of five new vessels next year will increase capacity by nearly 9 per cent.

The insulation to date of its typical European customer from the credit crunch – older couples with grown-up children and low borrowings – provides hope that bookings remain firm. However, it seems churlish to assume that rising unemployment and the erosion of its customers' wealth from falling stock markets will leave it wholly unscathed.

3.2 The short and long run

We will begin by considering a firm that employs two factors of production: labour in the form of workers and capital in the form of computers and office space.

The **short run** is a period of time where one factor of production is fixed. We tend to assume that capital is fixed and labour is variable.

The **long run** is a period of time when all factors of production are variable.

If a firm needs to increase its level of output in the **short run**, it is fairly easy to employ more workers. Agencies specializing in temporary employment are able to offer suitable candidates within a day, or even an hour. In contrast, it is not as easy to expand the amount of office space. It takes time to find additional buildings, arrange the finance to purchase the buildings, and then fit the buildings with suitable furniture and equipment. The problem also exists when trying to downsize. It is fairly easy to lay off workers, but it takes time to decommission a building and sell it to some other user. Therefore, only in the **long run** are all factors of production seen to be variable.

Given our business problem, we should not confine our thinking to capital as the only fixed factor of production. Clearly, the nature of employment can make labour fixed. Contracts signed by footballers, company chief executives and many academics are for a fixed period of time. Contracts for burger flippers and many other types of work are open-ended, with the employer and employee given the right to terminate the relationship with, typically, one month's notice. In the latter case, the employment of labour is reasonably variable, whereas for footballers labour is fixed.

A reasonable question is, how long is the long run? The answer is, it depends. For some companies it can be very long. Airlines place orders with aircraft suppliers up to five years in advance, while an Internet company might be able to buy an additional Internet server system within a week and double its output capacity.

However, an important issue is to understand how costs behave in the short and long run. In the next two sections we will see how in the short run costs are determined by the fixed amount of capital being exploited by more workers, while in the long run costs are influenced by varying the amount of capital.

3.3 The nature of productivity and costs in the short run

Productivity in the short run

If we are interested in knowing how the level of costs changes with the level of output, then we need to consider more than just the cost of employing labour and capital. We are also interested in understanding how the productivity of labour and capital changes. If labour becomes more productive, then output increases for any given amount of cost.

Total product is the total output produced by a firm's workers.

Marginal product is the addition to total product after employing one more unit of factor input.

In economics, **marginal** always means 'one more'.

In assessing productivity, we need to distinguish between **total product** and **marginal product**.

Consider the following. An online supplier of electrical goods has two vans for deliveries, the fixed factor of production. The firm can also employ up to ten workers, the variable component. The total product and marginal product at each level of employment are detailed in Table 3.1. When the firm employs one worker, total product is 40 delivered items per day. This worker has to collate the orders, pick the items from the warehouse, package them for delivery, print off invoices, load the van, deliver the items and then deal with any enquiries and returned items. When the firm employs a second worker, total output increases. This second worker can utilize the additional van and may specialize in dealing with enquiries and returns. When the third worker is employed, they do not have access to a van, but they could help by specializing in collating orders, picking and packing. This again would help to raise output. The fourth

Table 3.1 Total and marginal product of labour with a fixed amount of capital

Labour input (workers)	Total product (number of deliveries)	Marginal product of labour (number of deliveries)
1	40	40
2	90	50
3	145	55
4	205	60
5	255	50
6	295	40
7	325	30
8	345	20
9	355	10
10	360	5

Task specialization occurs where the various activities of a production process are broken down into their separate components. Each worker then specializes in one particular task, becoming an expert in the task and raising overall productivity.

worker might load vans and print invoices. The fifth worker might then help the third by specializing in picking orders from the warehouse; and so on and so on. The important point is that task specialization helps to raise productivity, as evidenced by the increasing marginal product for workers two, three and four, but thereafter diminishes. There is only so much **task specialization** that can occur without leaving a worker without a full day's work. Workers five, six and seven and onwards will be filling the remainder of their working day by answering emails, checking their text messages, making coffee and collecting sandwiches for lunch – activities which do not raise the total product of the firm.

The productivity of all the workers in our example is constrained by the number of vans the firm uses. With only two vans, there is an upper limit to how many orders can be met per day, no matter how much task specialization occurs at the warehouse.

The **law of diminishing returns** states that, as more of a variable factor of production, usually labour, is added to a fixed factor of production, usually capital, then at some point the returns to the variable factor will diminish.

Most working environments are characterized by a mixture of workers and capital, in various forms: lecturers and lecture theatres, office staff and computers, burger flippers and burger grills. The relationship depicted in Figures 3.1 and 3.2 is therefore very important and economists know it as the **law of diminishing returns**.

The law of diminishing returns is highlighted by the marginal product of labour (see Figure 3.2). When we have a fixed factor of production, such as capital, and we add workers to the production process, these workers can exploit an underutilized resource. So, the marginal product rises. When we begin to over-resource the production process with too much labour, there is no more capital to utilize. As a result, the marginal product begins to fall. This is the point at which the law of diminishing returns occurs. In our particular example, additional workers are able to exploit the vans and become more productive. But once we begin to employ more workers, and there are not enough vans, the productivity of labour must begin to fall.

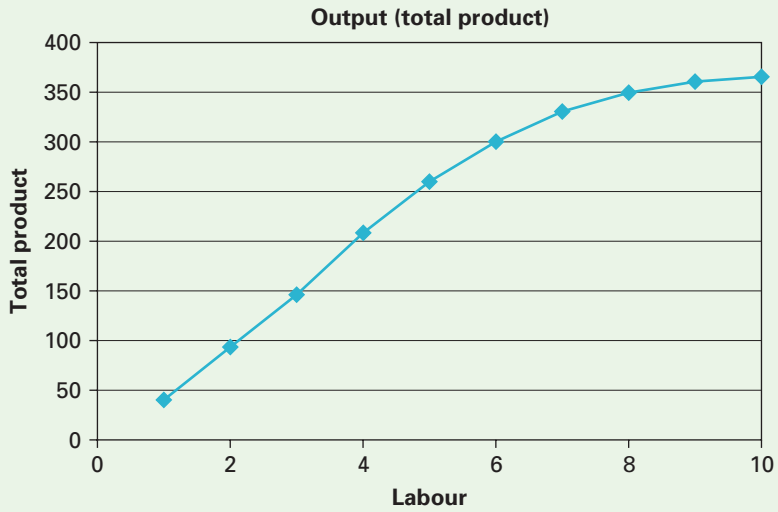

Figure 3.1 Total product of labour with a fixed amount of capital

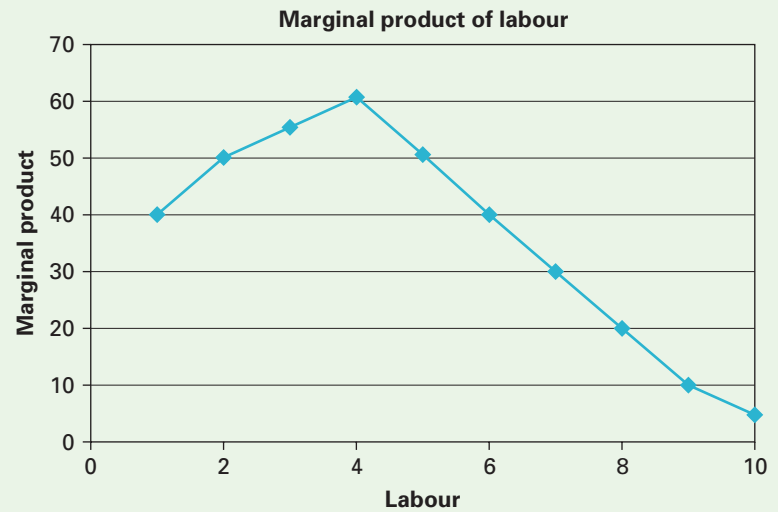

Figure 3.2 Marginal product of labour with a fixed amount of capital

Table 3.2 Short-run costs

Output	SFC (short-run fixed costs)	SVC (short-run variable costs)	STC (short-run total costs)
0	30	0	30
40	30	22	52
90	30	38	68
140	30	48	78
180	30	61	91
210	30	79	109
235	30	102	132
255	30	131	161
270	30	166	196
280	30	207	237

Variable costs are costs associated with the use of variable factors of production, such as labour.

Fixed costs are associated with the employment of fixed factors of production, such as capital.

Total costs are simply fixed costs plus variable costs.

Costs in the short run

Now that we have an understanding of how productivity changes, we need to begin to think about how costs behave. In the short run, we have three types of cost: **variable**, **fixed** and **total costs**.

Variable costs change with the level of output. This was picked up when we discussed the burger flippers. The higher the level of output, the more labour we employ and the higher the amount of variable cost.

Fixed costs do not change with the level of output. If we produce nothing, or a very large amount of output, fixed costs remain the same.

Each of these costs is listed in Table 3.2 for various levels of output, and plotted in Figure 3.3.

Fixed costs are represented as the purple line, which is horizontal. In this example, fixed costs are constant at £30. Variable costs rise, slowly; then, as output increases, they begin to rise more quickly. This simply reflects the law of diminishing returns. As additional workers become less productive, costs rise quicker than output. The total cost line in blue is simply fixed plus variable costs.

Average total cost is calculated as total cost divided by the number of units produced.

Average variable cost is calculated as total variable cost divided by the number of units produced.

Average fixed cost is calculated as total fixed costs divided by the number of units produced.

Average costs

The next step is to consider how the cost per unit changes with the level of output. We measure the cost per unit using **average cost**.

In addition to the average costs, we also examine the **marginal costs**, calculated as:

$$\frac{\text{Change in total cost}}{\text{Change in output}}$$

(Since the marginal cost is the cost of producing one more unit, the change in output should be 1.)

However, firms rarely increase output by one unit and in our example output initially increases from 0 to 40 units of output: therefore, by dividing the change in total cost by the change in output of 40, we can approximate the marginal cost, or the cost of making one more unit:

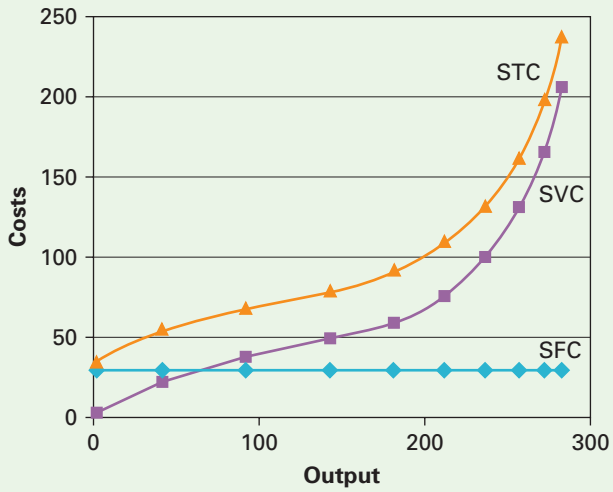

Figure 3.3 Short-run total, variable and fixed costs

Table 3.3 Short-run average and marginal costs

Output	SAFC (short-run average fixed costs)	SAVC (short-run average variable costs)	SATC (short-run average total costs)	SMC (short-run marginal costs)
0				
40	0.75	0.55	1.30	0.55
90	0.33	0.42	0.76	0.32
140	0.21	0.34	0.56	0.20
180	0.17	0.34	0.51	0.33
210	0.14	0.38	0.52	0.60
235	0.13	0.43	0.56	0.92
255	0.12	0.51	0.63	1.45
270	0.11	0.61	0.73	2.33
280	0.11	0.74	0.85	4.10

Marginal cost is the cost of creating one more unit.

Marginal cost = (52 – 30)/(40 – 0) = 0.55

The calculations for average and marginal costs are listed in Table 3.3, and plotted in Figure 3.4.

The average variable and average total cost curves are both U-shaped. This simply reflects the law of diminishing returns. Towards the left of the figure, the output is low. At this low level of output, we have a small number of workers using the fixed capital. As we employ more workers, productivity increases and costs per unit fall. As the number of workers continues to

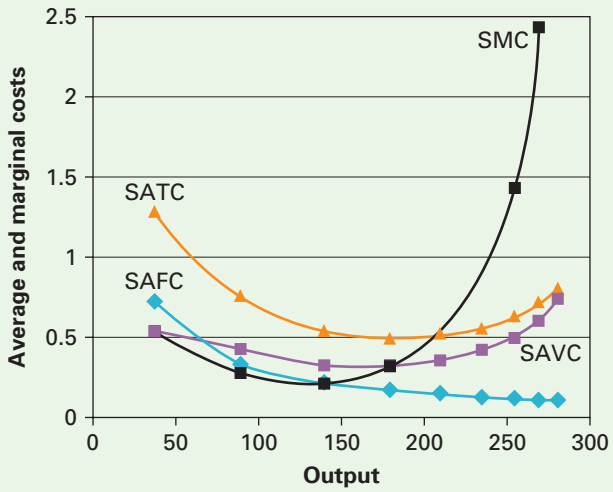

Figure 3.4 Plotted short-run average and marginal costs

increase, however, the law of diminishing returns predicts that productivity will fall. As a consequence, the cost per unit will increase. This point is also picked up in the marginal cost curve, which is the cost of producing one more unit. As labour becomes less productive, then costs of producing additional units must rise.

Relationship between the average and the marginal

It should also be noted that the marginal cost curve cuts through the minimum points of the average total and average variable cost curves. This is because of a simple mathematical relationship between the marginal and the average. Assume your average examination score is 50. Your next exam is your marginal exam. If you gain a score of 70, then your average will increase. But if you gain a score of 20, your average will come down. Therefore, whenever the marginal is lower than the average, the average will move down; and whenever the marginal is higher than the average, the average will rise. Therefore, the marginal cost curve has to cut through the average cost curves at their minimum point.

Average fixed costs

The average fixed cost curve is different. It is always falling as output increases. This reflects simple mathematics. If fixed costs are £100 and we produce ten units, the average fixed costs are £100/10 = £10. But if we increase output to 100 units, then average fixed costs become £100/100 = £1. Accountants refer to this as 'spreading the overhead'. As fixed costs are spread over a larger level of output, the fixed costs per unit will fall.

This relationship has important implications for managers. Consider the case of the Super Jumbo Airbus A380. Development costs have been estimated at €12 billion. If we assume Airbus finds two customers to buy the A380, the average fixed cost will be €12/2 billion = €6 billion. Therefore, in order for Airbus to break even, it will require its two customers to pay at least €6 billion; and then there is the cost of making the aircraft! Airbus has orders for just over 100 A380s, which helps to reduce the fixed cost per unit. But at a list price of €250 million, Airbus will have to sell many more A380s in order to recoup its variable costs of manufacturing and its fixed costs of development.

3.4 Output decisions in the short run

Now that we have an understanding of how costs behave in the short run, we can begin to examine the firm's output decisions. In Chapter 5 we will see how we can find the level of output that will maximize the firm's profits. However, at this point we merely wish to show you when the firm will produce and when it will close down.

If the output is being sold at the same price to all consumers for £1.50, then the average revenue is also £1.50. If we now re-examine the short-run average total costs, SATC in Table 3.3 and plotted in Figure 3.4, we can see that the maximum value for SATC is £1.30 at an output level of 40 units. As output grows, SATC drops to a minimum of £0.51. Clearly, therefore, at the current price of £1.50 the firm can make a profit at any output level.

Now consider two much lower prices, £0.45 and £0.30. At both prices the firm will make a loss as its minimum SATC is only £0.51, so its revenues will never be greater than its costs at either of these prices. But there is an important difference between the two scenarios. In the short run, the firm will operate and make a loss at prices of £0.45, but it will shut down and cease operating at prices of £0.30.

The understanding rests on whether or not the firm can make a positive contribution to its fixed costs. If the firm produces nothing, its fixed costs are £30 and its losses will also be £30. However, if the price is £0.45 there are output levels where the firm's average variable costs, SAVC, are less than £0.45. For example, at an output of 180 units, SAVC = £0.34. So, if the firm operates at 180 units of output, it can cover its variable cost per unit of £0.34 and have £0.45 − £0.34 = £0.11 per unit left over. Selling 180 units represents 180 × 0.11 =£19.80. The £19.80 can be used to make a contribution towards the fixed costs. So, by producing 180, the loss drops to £30 − £19.80 = £11.20, as opposed to a loss of £30 (the fixed costs) if it produced nothing.

However, when the price drops to £0.30 the firm cannot cover any of its variable costs. Therefore, if it did decide to operate, then, not being able to cover its entire wage bill, it would be adding to the losses generated by its fixed costs. Hence, the best the firm can do is to shut down and incur only the fixed-cost losses of £30.

We can now go one step further. The marginal cost is the cost of producing one more unit. If the firm can receive a price that is equal to or greater than the marginal cost, then it can break even or earn a profit on the last unit. If the firm maximizes profits, clearly it will supply an additional unit of output when the price is equal to or greater than marginal cost. If we couple this argument with the previous point, that firms will not operate below short-run average

Box 3.2 Theme parks

Theme parks offering thrilling rollercoaster rides often close down during the winter. We can now offer an economic explanation for why they close. The rides are capital and represent fixed costs. The staff who operate the rides and keep the theme park clean are the variable costs. During the summer months many people are willing to go to a theme park and pay the entrance fee. The revenues generated cover the theme park's fixed and variable costs. However, in the winter, when it is cold and wet, very few people are willing to go to the theme park. The revenues generated by the theme park would be unlikely to cover the wages it would have to pay to its staff to open the park. It is, therefore, best for the theme park to close and incur no variable costs during the winter; and simply incur its fixed costs. If the theme park decided to stay open during the winter, its losses would rise since the wage bill would not be covered by the small number of paying visitors to the park. Firms, therefore, are only willing to supply output if revenues are greater than variable costs.

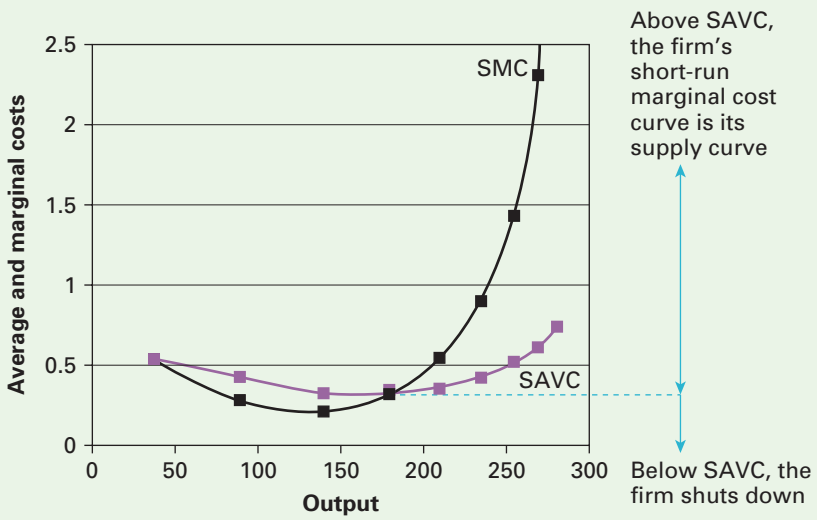

Figure 3.5 Firm's supply curve is related to the marginal cost curve

variable cost, we can show, as in Figure 3.5, that the firm's supply curve is in fact the firm's short-run marginal cost curve above short-run average variable costs.

3.5 Cost inefficiency

Our discussion so far has assumed that firms are operating on the cost curve. This is troublesome, since some firms are more cost-effective than their rivals; and in addition some firms are better at raising productivity over time. In Box 3.3, after suffering a huge financial loss, British Airways is seeking to get as near as possible to its cost curve in order to improve efficiency.

If firms have the same productive technology, they have the same knowledge and manufacturing know-how. As such, they are assumed to share the same cost curves. However, if one firm pays more for its workers, or uses them less effectively, then this firm will operate off its cost curve, as illustrated in Figure 3.6.

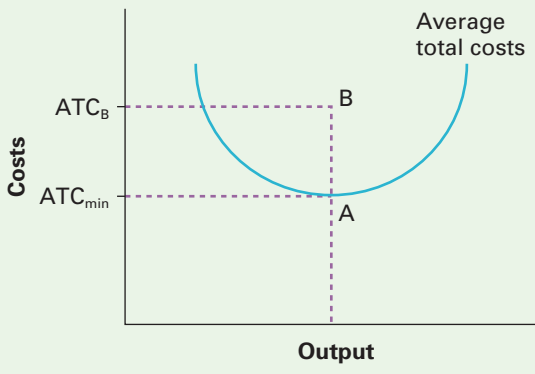

Figure 3.6 Cost inefficiency

Box 3.3 British Airways posts loss

Adapted from 'British Airways Posts Loss, Focuses on Exchange Rates' by Kaveri Niththyananthan in the Wall Street Journal, *9 February 2009*

British Airways posted a net loss of £127 million ($188 million) for the nine months ended December 31, compared with a year-earlier net profit of £642 million. The latest results were hit by a 48 per cent spike in fuel costs to £2.24 billion. The carrier didn't break out quarterly results.

'We have already taken several actions to offset the unprecedented economic conditions,' BA Chief Executive Willie Walsh said. 'We have increased our sales activity in markets with stronger foreign currencies to benefit from exchange rates and continue to offer competitive fares in both premium and nonpremium cabins.'

Mr Walsh said BA would continue to review its business to control costs while improving customer service. The airline has begun talks with trade unions about pay and productivity, a move BA said was necessary to improve financial performance. BA will use a voluntary-layoff plan similar to the one offered to managers, Mr Walsh said. About 450 managers took up BA's offer for severance last autumn.

He declined to comment on the number of job cuts the airline was targeting. All departments will be looked at to see how efficiency can be improved, a BA spokeswoman said. A 'consolidation of roles' is under consideration, she continued. An example could include making Heathrow Airport cabin crew work long- as well as short-haul routes, which is already the case at Gatwick Airport.

Firms A and B are both operating at the output level which is associated with the lowest short-run average total cost. However, only A is operating on the curve and achieving minimum average total cost ATC_{min}. B has much higher costs and this reflects a significant degree of cost inefficiency and, as such, A has a cost advantage over its rival. The reasons why this can occur are numerous, and in the case of British Airways relate to the employment of too many workers and an ineffective roster system. This means that British Airways is at point B and its more efficient rivals are at point A.

3.6 The nature of productivity and costs in the long run

In the long run, both capital and labour are variable. Firms can change the number of machines or the amount of office space that they use. Therefore, the law of diminishing returns does not determine the productivity of a firm in the long run. This is simply because there is no fixed capital in the long run to constrain productivity growth. So, in the long run, productivity and costs must be driven by something else. This something else is termed **returns to scale**.

Returns to scale simply measure the change in output for a given change in the inputs.

Increasing returns to scale exist when output grows at a faster rate than inputs. Decreasing returns exist when inputs grow at a faster rate than outputs. Constant returns to scale exist when inputs and outputs grow at the same rate.

This is not complicated. Look at Figure 3.7: in quadrant 1, we have the short-run average total cost curve, SATC, with which we are familiar. Now consider adding more capital and labour to the production process.

In so doing we have changed the scale of operation and we now have a new cost curve. In quadrant 2, we have the situation where the new cost curve $SATC_2$ moves down and to the right. The company can now produce the same level of output Q_1 for the lower average cost of

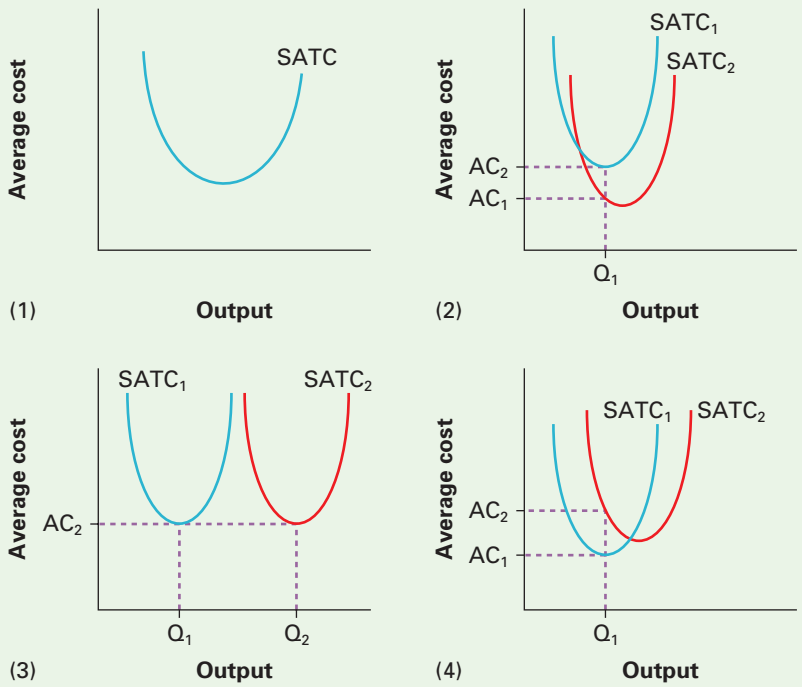

Figure 3.7 Changing the capital input and impact on short-run cost curves

When a firm changes its level of capital, e.g. machines, number of offices or shops, it moves to a new short-run cost curve. If the investment in capital makes the firm more efficient, then the cost curve will move down to the right, as in quadrant 2. If investment in capital leaves productivity unchanged, as in quadrant 3, then there is no change in average costs. If capital investment makes the firm less productive, then average costs will increase, as in quadrant 4.

AC_2. This is increasing returns to scale. As we increase inputs, outputs grow faster, so the cost per unit must fall. In quadrant 3, increasing the scale moves the cost curve $SATC_2$ to the right and leaves average costs constant, a case of constant returns to scale. In quadrant 4, increasing scale leads to the new cost curve $SATC_2$ shifting upwards and to the right, leading to an increase in costs, a case of decreasing returns to scale.

What economists tend to find in practice is that firms experience increasing, then constant and finally decreasing returns to scale: that is, firms move through quadrants 2, 3 and 4 in order. Therefore, the family of short-run cost curves can be put together and the long-run cost curve can be derived, as in Figure 3.8.

The long-run average total cost curve, LATC, is a frontier curve. It shows all the lowest long-run average costs at any given level of output and is really nothing more than a collection of short-run cost curves. What we can clearly see, however, is that as we increase the scale of operation, the long-run average cost initially falls and then begins to increase. So, the long-run cost curve is also U-shaped. However, the reason for the U-shape is not the law of diminishing returns; rather, in the long run economies of scale are the important issue.

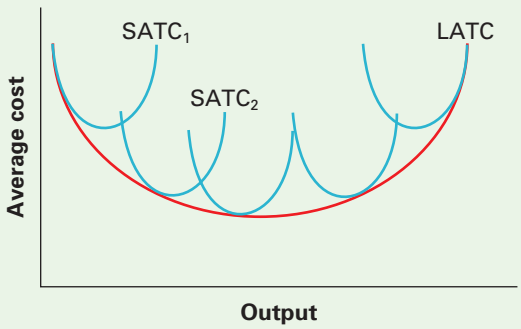

Figure 3.8 Long-run average costs

The long-run average cost curve is simply a collection of short-run average cost curves, illustrating how costs change as fixed inputs.

Economies of scale: production techniques

Through **economies of scale** long-run average costs fall as output increases.

Economies of scale exist for a number of reasons. Consider the production process associated with making Fords and Ferraris. At a Ford production facility, workers might be capable of making 1000 cars in a 24-hour shift. Ferrari workers may only make 1000 cars in a year. At massive levels of scale, Ford employs mass-production techniques; one person is responsible for fixing tyres, another for exhausts. This task specialization aids productivity and cuts costs. At Ferrari it is not possible to use mass-production techniques. The scale of operation is much lower. Therefore, as firms change their level of scale, they also change their production process and long-run costs fall.

The same consideration also applies to the generation of food miles, where it now appears that the economies of scale generated through global transportation of food result in lower CO_2 emissions than for food driven in small batches from local producers. See Box 3.4.

Box 3.4 Why long-haul food may be greener than local food with low air-miles

Adapted from an article by Richard Woods in The Times, *3 February 2008*

If you buy a packet of Waitrose blueberries from Chile, it's a crime against humanity. If you nibble mange tout from Africa, you're practically murdering the planet. And if you eat apples from New Zealand, well, you're in league with the devil.

Why? Food miles, of course. It's obvious that if you buy food from thousands of miles away, the transport alone must consume vast amounts of energy, thus fuelling climate change and global meltdown. As any concerned citizen knows, think green, think local. Or think again. Researchers are finding that food miles are far from the whole story when assessing the environmental impact of what we eat.

Local production and a distribution system involving lots of vans and cars miss the environmental benefits of economies of scale. Just over a ton of goods moved six miles as part of a 22-ton lorry load generates about 14 oz of CO_2; moved in 50 cars, each carrying 40 lb, it generates about 22 lb of CO_2.

Indivisibilities

In order to operate as a commercial airline you have to buy a jumbo jet. Assume the jumbo has 400 seats and you plan to fly between Manchester and Dubai, but only manage to find 300 passengers a day. You cannot chop off the back of the plane to cut your costs! But if you increase your scale and buy a second plane and use this to fly between Dubai and Hong Kong, you might find another 100 passengers who wish to fly Manchester to Hong Kong, via Dubai. In essence, this is nothing more than spreading fixed costs. The same arguments can be made regarding professional corporate staff. A company may only need one accountant, one lawyer and one marketing executive. In a small company there are not many accounts to manage, many contracts to negotiate and sign, or many marketing campaigns to organize. However, as the scale of the company grows, the utilization of these expensive professional staff improves. The accountant manages more accounts and the lawyer oversees more contracts and, as a result, the cost per unit of output falls. Box 3.5 discusses the world's tallest building, Burj Dubai. The indivisibility is land space. Once this has been purchased it can be increasingly exploited by building more floors. Air space is free, land space is not. Therefore, while often being monuments to engineering ingenuity and visually appealing, skyscrapers rest on the economic foundations of economies of scale. This is very true in areas of high population density and where land prices are high: New York, Shanghai, Taipei and Dubai – all places where skyscrapers are popular.

Box 3.5 Dubai claims record for world's tallest building

Adapted from an article in The Times*, 1 September 2008*

Developers in Dubai have claimed a new record for the tallest building in the world, saying that the *Burj Dubai* skyscraper has now topped 688 metres (2257 feet). The slender, rocket-shaped tower is still under construction. Its final height remains a closely guarded secret, although it is expected to reach 800 metres.

Emaar Properties announced last summer that the skyscraper had surpassed Taiwan's Taipei 101, which – at 508 metres (1667 feet) – had been officially the world's tallest building since 2004. For the time being, Taipei 101 is still the world's tallest inhabited structure.

In a laconic statement issued today, the developer said that work on the exterior of Burj Dubai was now almost finished and construction would soon begin on the interior. So far the silvery steel-and-glass construction has soared more than 160 storeys into the air. The company gave no further details.

Geometric relationships

Have you ever noticed that bubbles are always round? Engineers and business managers have. Bubbles are round because they provide the biggest volume for the smallest surface area. More specifically, volume grows at a faster rate than the surface area. Volume is a measure of storage capacity. So, if we need to create a tank to brew beer, and we decide to double the volume of the tank, the material needed to cover the surface area, the sides and bottom, will not double in size. Instead, it will grow at a slower rate. Hence, it becomes proportionately cheaper to build larger tanks than it does to build smaller tanks. Look around your lecture theatre – we expect it will be big.

Diseconomies of scale

Long-run average costs will eventually begin to rise. The most obvious reason is that, as companies increase in size, they become more difficult to control and co-ordinate. More managerial input is required to run the business and managers themselves require additional management. So, as the scale of the company increases, the average cost also increases. Excessive bureaucracy now offsets any productivity gains.

Competitive issues

The issue of long-run costs has important insights for a competitive assessment of one firm against another. The lowest point on the long-run average total cost curve is defined as the **minimum efficient scale**. This is illustrated in Figure 3.9.

The **minimum efficient scale** (MES) is the output level at which long-run costs are at a minimum.

If a company operates at a level of scale significantly below the minimum efficient scale, then it is likely to be uncompetitive, with higher average costs.

The size of this cost disadvantage varies. In some industries, economies of scale are small and the long-run average cost curve is fairly flat across all output ranges. In other industries, economies of scale are significant and the long-run cost curve is markedly U-shaped. As a general rule, industries that are capital intensive generate higher fixed costs and lead to higher minimum efficient scale. Supermarkets, banking and car manufacturing all require large capital inputs and therefore exhibit high minimum efficient scale. In contrast, hairdressing, firms of solicitors and window cleaners do not require significant capital inputs. Minimum efficient scale in these industries is less of an issue.

In order to deal with an uncompetitive cost base, companies can try to do a number of things. First, they might merge with another company in the same line of business. Clearly, the new company will be bigger than the two separate parts and economies of scale can be realized.

Managers often propose mergers as a way of pursuing cost economies. But they could just as well be pursuing market power. A merger effectively reduces the amount of competition in the market. This lowers the price elasticity of demand for the merged company's product. The bigger company has one less competitor and, therefore, has more scope to raise its prices.

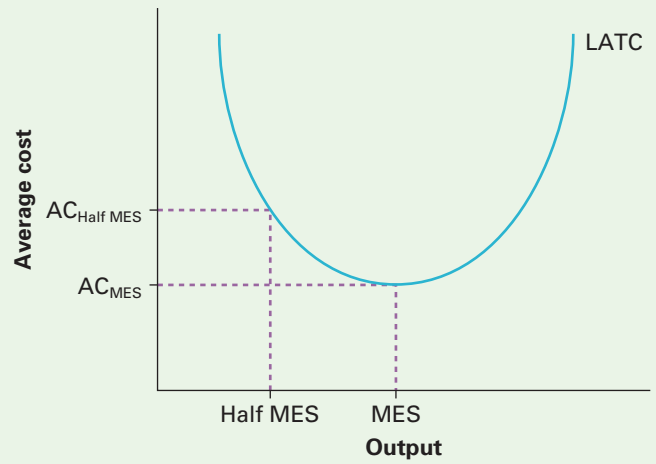

Figure 3.9 Average costs and the minimum efficient scale

The minimum efficient scale (MES) is the size of operation with the lowest average cost. Operating with a company size only half of the MES results in higher average costs.

3.7 Business application: linking pricing with cost structures

Fixed costs have been a dominant feature of this chapter. Professional footballers were shown in the business problem to be fixed costs. The development of the Airbus A380 was seen as a fixed cost; and the indivisibility of a skyscraper was also seen as a fixed cost.

In every example, the fixed cost is a major component of total costs. Because an Airbus A380 without fuel weighs around 280 tons, the cost of moving the plane between two airports massively outweighs the cost of moving you and your suitcase. In fact, most airlines would let you fly between London and Sydney for as little as £30 – the same amount as many cheap flights from the UK to some European destinations. This trivial amount is again the variable cost and this time is associated with the cost of issuing tickets, handling your luggage and feeding you en route. This is nothing more than the marginal cost of carrying you between two cities. Prices above £30 are a bonus. Using this cost-based knowledge, we can now explore the commercial decisions faced by the airlines that have ordered A380s.

More than any other commercial aircraft the A380 is a fixed cost for its operators, and moving the huge airframe between airports represents the bulk of the operators' costs. Interestingly, the aircraft is certified to carry 853 passengers, yet airlines appear to be ordering seating configurations between 480 and 580, presumably filling the free space with extra leg room, bars, gyms and other in-flight leisure facilities. However, we know that volume is crucial when fixed costs are high, because additional volume helps to spread the fixed cost over additional units of output. This lowers cost per unit sold, which ultimately lowers prices. With a simple piece of economic knowledge, it is easy to envisage airlines very quickly moving towards 850 seats on A380s in the pursuit of a cost advantage over their rivals. History also provides a precedent. When the Boeing 747 was first launched, no one knew what to place inside the front end 'bubble'. Ideas of gyms and bars were discussed, before operators decided on extra seating.

Discount airlines, while not yet flying A380s, gain competitive advantage by being cost efficient. They know how to keep variable costs down through no-frills service and they are extremely effective in dealing with their fixed costs. Load factor is reported by all discount carriers such as Ryanair and easyJet on a monthly basis. Load factor measures how good the airline is at selling all its available seats, and discount carriers can often achieve a load factor of 85 per cent, beating their scheduled rivals by 20 percentage points. As suggested earlier, the aircraft is a fixed cost of many millions of pounds. But also, as a scheduled airline, the company has committed to fly between two cities on any given day. So, if it flies with no passengers, or a full plane, the airline will still incur fuel costs, staff costs and airport fees. In a sense these costs are also fixed, as they do not vary with the level of output, in this case the number of passengers carried. In the case of no-frills easyJet, the variable costs are exceptionally low as no meals are offered and all tickets are electronic. Therefore, with such high fixed costs, airlines need to utilize their assets. They have to push volume through the aircraft and fill as many seats as possible. Each passenger makes a contribution to paying the huge fixed costs. The more passengers you carry, the more likely it is that you will be able to pay all of your fixed costs. Once this is achieved, you start to make profits.

How do you drive volume through an aircraft? The simple answer is volume itself. For example, if it costs £10 000 to fly a jet between Manchester and Amsterdam and the plane carries 50 passengers, then the average fixed cost per passenger is £10 000/50 = £200. Then the company needs to charge at least £200 per passenger and this is only for a one-way ticket! But if the plane carries 150 passengers, then the average fixed cost is £10 000/150 = £67.

From demand theory we know that we can generate higher demand at lower prices. So, we can drive volume by dropping the price. In part, easyJet tries to achieve this with a twist. If you

want to book a flight three months in advance the price will be very cheap. This is because easyJet have lots of seats available and they have a higher need to drive volume. Once momentum picks up in the market and the flight date approaches, it raises the price and begins to extract profits from late bookers. But, crucially, what can be observed from a business perspective is that easyJet is using a fine-tuned pricing strategy to deal with a cost-based problem.

However, we should not be fooled into thinking that in ordering A380s with only 480 seats the likes of Singapore Airlines have got it all wrong. This is because Singapore Airline bums are worth more money; easyJet succeeds in driving the load factor forward by sacrificing revenue. Its heavy discounts in the marketplace are used to drive sales volumes. But driving volumes through price reduction damages revenue yields, and easyJet counters this revenue strategy by also minimizing its costs. It is a no-frills airline.

So, no meals, no reissue of the ticket if you miss the flight, plus the use of unpopular airports where the landing fees are lower. In contrast, Singapore Airlines uses popular airports. It undertakes extensive brand development. It provides meals and drinks onboard. It will assist passengers who have missed their flight. In summary, Singapore Airlines provides more than simply a means of transport between two points. It also provides extras such as late checking, drinks and meals during the flight and rerouting if you miss your flight. In addition, some of the earlier adopters of the A380 such as Singapore Airlines have an ability to offer a unique travel experience and can charge a premium price – see Box 3.6. With few other operators owning an A380, at least in the early years after launch, the demand for a flight on an A380 will be price inelastic. The added extras of gyms and bars are designed to exploit this demand. However, in ten years' time, when the world is awash with A380s, 850 seats is likely to be common; and do not be surprised if easyJet or Ryanair owns one, or two, for short hops into Europe.

Box 3.6 The search for the best A380

Adapted from an article by Richard Green in The Times, *18 January 2009*

Yesterday, the first Qantas A380 Superjumbo took off from Heathrow, bound for Sydney. There are now three airlines flying these monster planes from London to Australia – Singapore Airlines, Emirates and Qantas – but each is flying different routes and each is offering completely different onboard amenities, services and fares.

The latest to enter the fray, Qantas, offers an A380 all the way from Heathrow to Sydney, with return fares from £699 (the same as to Melbourne on a 747). Its rivals, by contrast, are looking to cash in by charging considerably more for some of their A380 flights. With Emirates, an A380 return from Heathrow to Dubai starts at £530; its four daily non-A380 flights start at £305. And business class with Singapore is a whopping 60 per cent extra: from £3403 return to Changi, as opposed to £2127 on a 747.

3.8 Business application: footballers as sweaty assets

A common business term for making your fixed inputs work harder is 'to sweat the assets' and this is exactly what easyJet is trying to do by making its planes operate at maximum capacity. But how are Premiership football teams utilizing their very expensive football stars?

Few football clubs are looking at the huge expense of footballers as a problem that requires a pricing solution. Admittedly, pricing may play a role. Football fans are willing to pay a higher

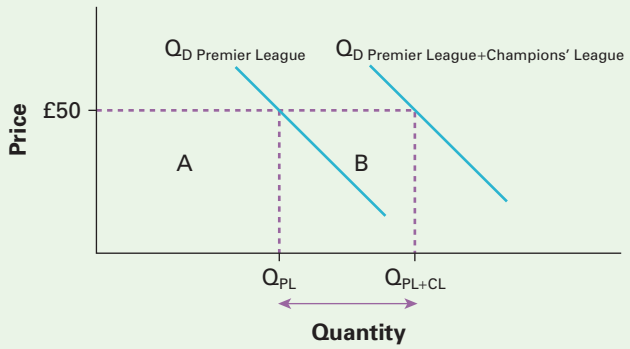

Figure 3.10 Demand for Premiership games and the Champions' League

Higher output resulting from more football games played yields more total revenue. This can go to paying the large fixed costs associated with employing top-class footballers.

price to watch a top Premiership side than, say, a Championship one. But the real and most obvious solution for Premiership sides is to increase the volume of games played.

In Figure 3.10, we have the demand for tickets at football games. Assuming the ticket price is £50, the demand curve for Premiership games indicates how many fans will buy at £50. Total revenue from Premiership games is illustrated by rectangle A. If the team qualify for the Champions' League, then more games are played and ticket demand rises. Assuming a similar ticket price of £50, rectangle B defines the additional total revenue. In the recent past, Manchester United have been very successful in using this strategy. By focusing on qualifying for the Champions' League and progressing within the competition they can literally sweat their assets, namely the players. (Admittedly, making sports stars work harder may diminish their average performance and make them injury prone, so there could also be a variable cost to playing more games.)

However, by selling TV rights to their games, replica team kits and other merchandizing products, Manchester United do not rely only on the revenue streams from the turnstiles. However, once they fail to progress within the Champions' League, then a financial hole appears in their business model. Players are utilized less, resulting in less TV revenue and gate receipts. Moreover, the value of the brand and the worth of merchandise decreases. Exposure and utilization of the players is a critical success factor for the business model underpinning the club.

Whether the problem is easyJet's or Manchester United's, it is the same problem: one of exploiting fixed costs. Economics provides you with an ability to identify this type of problem and suggests some possible solutions. Implementing and managing the strategic solution is perhaps a more challenging problem.

Summary

1. In the short run one factor of production, usually capital, is assumed to be fixed.
2. Adding more variable factors of production, such as labour, to a fixed amount of capital will eventually lead to diminishing returns. This can be illustrated by plotting the marginal product of labour.

3 The impact of diminishing returns is a gradual decline in the productivity of labour. This lower productivity leads to a rise in average costs per unit.

4 The U-shaped nature of the average total and average variable cost curve is related to the change in productivity brought about by the diminishing returns.

5 Average fixed costs are always declining, as the fixed costs are divided by higher levels of outputs.

6 Marginal cost is the cost of producing one more unit. The marginal cost curve is, in effect, a reflection of the marginal product curve for labour. As marginal product declines due to the law of diminishing returns, the marginal cost increases.

7 In the long run all factors of production are variable. Costs are no longer determined by the law of diminishing returns. Instead, they are related to economies of scale.

8 Initially, as companies grow in size, they benefit from economies of scale and unit costs fall. But eventually they will grow too big and diseconomies of scale will cause average costs to rise.

9 High levels of fixed costs generally require high levels of volume.

Learning checklist

You should now be able to:

- Explain the difference between the short and long run
- Calculate and explain the difference between variable, fixed and total costs
- Explain the concepts of marginal product and marginal costs
- Explain and provide examples of the law of diminishing returns
- Understand the concept of economies of scale and explain why economies of scale may exist
- Explain the concept of minimum efficient scale and understand the importance of operating at the minimum efficient scale
- Explain, using reference to fixed costs, why budget airlines sell at low prices
- Provide economic reasons relating to costs as to why Premiership clubs wish to be in the Champions' League

Questions connect™

1 Explain the difference between the short and the long run.

2 Is it sensible to consider capital, rather than labour, as a fixed factor of production?

3 How does the law of diminishing returns explain the short-run productivity of a firm?

4 What is the difference between total fixed costs, total variable costs and total costs?

5 In the short run, why do average total costs initially fall and then increase?

6 Explain why average fixed costs are always declining. What commercial strategies can be supported by falling average fixed costs?

7 What are marginal product and marginal costs?

8 Marginal costs must go through the minimum point of which other cost curves: average total costs, average variable costs, or average fixed costs?

9 When should a firm shut down? Is it when prices go below average total costs, or average variable costs? Explain.

10 It is reported in the news that two firms have agreed to merge in the belief that they can generate cost savings. Which economic idea would support this belief?

11 Explain why airlines suspend some of their routes during the winter.

12 What are economies of scale and what are considered to be the main sources of economies of scale?

13 From a cost perspective, why do you think ice cream is on special offer in November, but not in July?

14 Is it ever sensible to operate at prices below average variable costs?

15 Do economies of scale offer a competitive advantage?

Exercises

1 True or false?
(a) Specialization can lead to economies of scale.
(b) Holding labour constant while increasing capital will lead to diminishing returns.
(c) The long-run cost curve meets the bottom of each short-run cost curve.
(d) Pursuit of minimum efficient scale can be a reason for merger.
(e) A rising marginal cost is a result of diminishing returns.
(f) Investing in brands represents a fixed cost.

2 A firm faces fixed costs of £45 and short-run variable costs (SAVC) as shown in Table 3.4.

Table 3.4 Short-run costs of production

Output	SAVC	SAFC	SATC	STC	SMC
1	17				
2	15				
3	14				
4	15				
5	19				
6	29				

(a) Fill in the remainder of the table, where SAFC is the short-run average fixed cost; SATC is the short-run average total cost; STC is the short-run total cost; and SMC is the short-run marginal cost.
(b) Plot SAVC, SAFC, SATC and SMC, checking that SMC goes through the minimum points of SAVC and SATC.
(c) The firm finds that it is always receiving orders for six units per week. Advise the firm on how to minimize its costs in the long run. Now consider Table 3.5.

Table 3.5 Short- and long-run decisions

Price	Short-run decision			Long-run decision		
	Produce at a profit	Produce at a loss	Close down	Produce at a profit	Produce at a loss	Close down
18.00						
5.00						
7.00						
13.00						
11.50						

Cost conditions are such that LAC is £12; SATC is £17 (made up of SAVC £11 and SAFC £6). In Table 3.5, tick the appropriate short- and long-run decisions at each price.

3 Referring to Box 3.6, consider the following questions:
(a) What type of costs do aircraft represent to airlines?
(b) Explain and evaluate the different strategies used by airlines to deal with the cost of running A380s.