BBM 102/05 Microeconomics course guide

URL	http://weko.wou.edu.my/?action=repository_uri&item_id=339

Unit 3

BBM 102/05

Microeconomics

Firm Organisation, Production and Cost

wawasan open UNIVERSITY

the people's university

COURSE TEAM

Course Team Coordinator: Mr. Prakash V. Arumugam
Content Writer: Mr. Prakash V. Arumugam
Instructional Designer: Mr. Khoo Chiew Keen
Academic Member: Dr. Leow Ghin Yin

COURSE COORDINATOR

Mr. Prakash V. Arumugam

EXTERNAL COURSE ASSESSOR

Professor Dr. Cheah Kooi Guan, Kwantlen Polytechic University, Canada

PRODUCTION

Editor: Mr. Khoo Chiew Keen
Graphic Designer: Ms. Chrisvie Ong

Wawasan Open University is Malaysia's first private not-for-profit tertiary institution dedicated to adult learners. It is funded by the Wawasan Education Foundation, a tax-exempt entity established by the Malaysian People's Movement Party (Gerakan) and supported by the Yeap Chor Ee Charitable and Endowment Trusts, other charities, corporations, members of the public and occasional grants from the Government of Malaysia.

The course material development of the university is funded by Yeap Chor Ee Charitable and Endowment Trusts.

Wawasan Open University
Jalan Sultan Ahmad Shah,
10050 Penang.
Tel: (604) 2180333   Fax: (604) 2279214
Email: enquiry@wou.edu.my
Website: www.wou.edu.my

Contents

Unit 3 Firm Organisation, Production and Cost

Unit Overview

In Unit 1, you studied the demand-supply framework and used the framework to study market efficiency. We did not, however, discuss the behaviour of a firm in detail. To give you a more complete picture of the demand-supply framework, we need to analyse the behaviour of firms in more detail, particularly the supply curve that forms the core of this unit.

A firm in standard economics is very simple. It is just an entity that employs factors to produce goods/services and to **maximise profit**. The profit maximisation problem can be differentiated into two parts: **cost minimisation** and **profit maximisation**. The first part involves the choice of input combinations and the second involves the *choice of output levels*.

First, we will study the cost minimisation problem. We will introduce the notion of a **production function** and describe how the **cost function** can be derived from a production function. We will also introduce various measures of cost (total cost, average cost, marginal cost, fixed cost, variable cost and other costs). Then, the concepts of **long-run** versus **short-run costs** will also be introduced in terms of adjustments of levels of fixed factors.

Next, we will study the profit maximisation problem, given the cost function. We will introduce the concept of **revenues** and the various measures of revenues. Later, we will describe the structure of profit maximisation.

We want to discuss the simplest profit maximisation problem; namely, profit maximisation of competitive firms. We will first discuss the meaning of a **competitive market** and then discuss the profit maximisation behaviour of competitive firms.

Unit Objectives

By the end of Unit 3, you should be able to:

1. Explain the theory of a firm.
2. Describe the objective of the firm as presented in standard economics: profit maximisation.
3. Define opportunity cost, explicit and implicit cost.
4. Distinguish accounting and economic profit.
5. Differentiate cost minimisation and profit maximisation and compare and contrast the complexity of the two problems.

6. Analyse the link between a firm's production process and its total costs.

7. Distinguish the relationship between short-run and long-run costs.

8. Explain the meaning of competition.

9. Describe the profit maximisation behaviour of competitive firms.

3.1 Production Choices and Costs: The Short Run

Objectives

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

1. Describe short-run production function, total product, average product, and marginal product and explain and illustrate how they are related to each other.

2. Explain the concepts of increasing, diminishing, and negative marginal returns and explain the law of diminishing marginal returns.

3. Describe total variable cost, total fixed cost, total cost, average variable cost, average fixed cost, average total cost, and marginal cost and explain and illustrate how they are related to each other.

4. Explain and illustrate how the product and cost curves are related to each other and to determine in what ranges on these curves marginal returns are increasing, diminishing, or negative.

Introduction

Our analysis of production and cost begins with a period economists call the short run. The short run in this microeconomic context is a planning period over which the managers of a firm must consider one or more of their factors of production as fixed in quantity. For example, a restaurant may regard its building as a fixed factor over a period of at least the next year. It would take at least that much time to find a new building or to expand or reduce the size of its present facility. Decisions concerning the operation of the restaurant during the next year must assume the building will remain unchanged. Other factors of production could be changed during the year, but the size of the building must be regarded as a constant.

When the quantity of a factor of production cannot be changed during a particular period, it is called a fixed factor of production. For the restaurant, its building is a fixed factor of production for at least a year. A factor of production whose quantity can be changed during a particular period is called a variable factor of production; factors such as labour and food are examples.

While the managers of the restaurant are making choices concerning its operation over the next year, they are also planning for longer periods. Over those periods, managers may contemplate alternatives such as modifying the building, building a new facility, or selling the building and leaving the restaurant business. The planning period over which a firm can consider all factors of production as variable is called the long run.

At any one time, a firm will be making both short-run and long-run choices. The managers may be planning what to do for the next few weeks and for the next few years. Their decisions over the next few weeks are likely to be short-run choices.

Decisions that will affect operations over the next few years may be long-run choices, in which managers can consider changing every aspect of their operations. Our analysis in this section focuses on the short run. We shall examine the long-run choices in later sections.

The short-run production function

A firm uses factors of production to produce a product. The relationship between factors of production and the output of a firm is called a production function. Our first task is to explore the nature of the production function.

Consider a hypothetical firm, Acme Clothing, a shop that produces jackets. Suppose that Acme has a lease on its building and equipment. During the period of the lease, Acme's capital is its fixed factor of production. Acme's variable factors of production include things such as labour, cloth, and electricity. In the analysis that follows, we shall simplify by assuming that labour is Acme's only variable factor of production.

Total, marginal and average products

Figure 3.1 shows the number of jackets Acme can obtain with varying amounts of labour (in this case, tailors) and its given level of capital. A total product curve shows the quantities of output that can be obtained from different amounts of a variable factor of production, assuming other factors of production are fixed.

Point on graph	A	B	C	D	E	F	G	H	I
Units of labor per day	0	1	2	3	4	5	6	7	8
Jackets per day	0.0	1.0	3.0	7.0	9.0	10.0	10.7	11.0	10.5

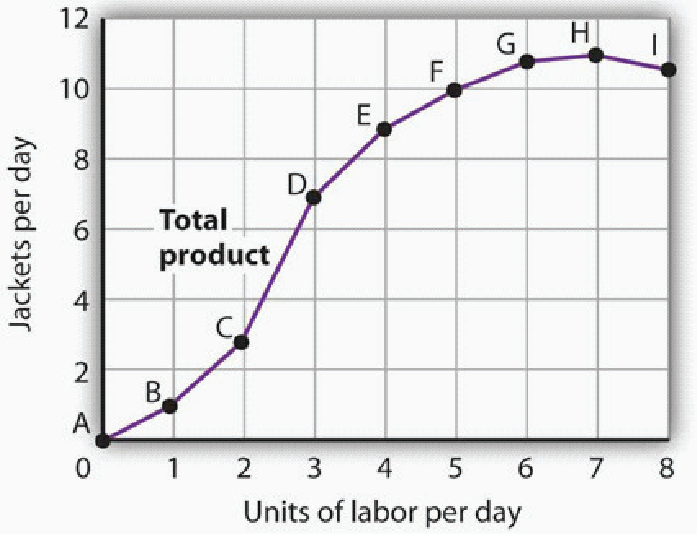


Figure 3.1 Acme clothing's total product curve

The table gives output levels per day for Acme Clothing Company at various quantities of labour per day, assuming the firm's capital is fixed. These values are then plotted graphically as a total product curve.

Notice what happens to the slope of the total product curve in **Figure 3.1**. Between 0 and 3 units of labour per day, the curve becomes steeper. Between 3 and 7 workers, the curve continues to slope upward, but its slope diminishes. Beyond the seventh tailor, production begins to decline and the curve slopes downward. We measure the slope of any curve as the vertical change between two points divided by the horizontal change between the same two points. The slope of the total product curve for labour equals the change in output (ΔQ) divided by the change in units of labour (ΔL):

Slope of the total product curve = $\Delta Q/\Delta L$

The slope of a total product curve for any variable factor is a measure of the change in output associated with a change in the amount of the variable factor, with the quantities of all other factors held constant. The amount by which output rises with an additional unit of a variable factor is the marginal product of the variable factor. Mathematically, marginal product is the ratio of the change in output to the change in the amount of a variable factor. The marginal product of labour (MP_L), for example, is the amount by which output rises with an additional unit of labour. It is thus the ratio of the change in output to the change in the quantity of labour ($\Delta Q/\Delta L$), all other things unchanged. It is measured as the slope of the total product curve for labour.

Equation 3.1

$MP_L = \Delta Q/\Delta L$

In addition we can define the average product of a variable factor. It is the output per unit of variable factor. The average product of labour (AP_L), for example, is the ratio of output to the number of units of labour (Q/L).

Equation 3.2

$AP_L = Q/L$

The concept of average product is often used for comparing productivity levels over time or in comparing productivity levels among nations. When you read in the newspaper that productivity is rising or falling, or that productivity in the United States is nine times greater than productivity in China, the report is probably referring to some measure of the average product of labour.

The total product curve in Panel (a) of **Figure 3.2** is repeated from **Figure 3.1**. Panel (b) shows the marginal product and average product curves. Notice that marginal product is the slope of the total product curve, and that marginal product rises as the slope of the total product curve increases, falls as the slope of the total product curve declines, reaches zero when the total product curve achieves its maximum value, and becomes negative as the total product curve slopes downward. As in other parts of this text, marginal values are plotted at the midpoint of each interval. The marginal product of the fifth unit of labour, for example, is plotted between 4 and 5 units of labour. Also notice that the marginal product curve intersects the average product curve at the maximum point on the average product curve. When marginal product is above average product, average product is rising. When marginal product is below average product, average product is falling.

Units of labor per day	0	1	2	3	4	5	6	7	8
Jackets per day	0	1.0	3.0	7.0	9.0	10.0	10.7	11.0	10.5
Marginal product		1.0	2.0	4.0	2.0	1.0	0.7	0.3	−0.5
Average product	–	1.0	1.5	2.33	2.25	2.0	1.78	1.57	1.31

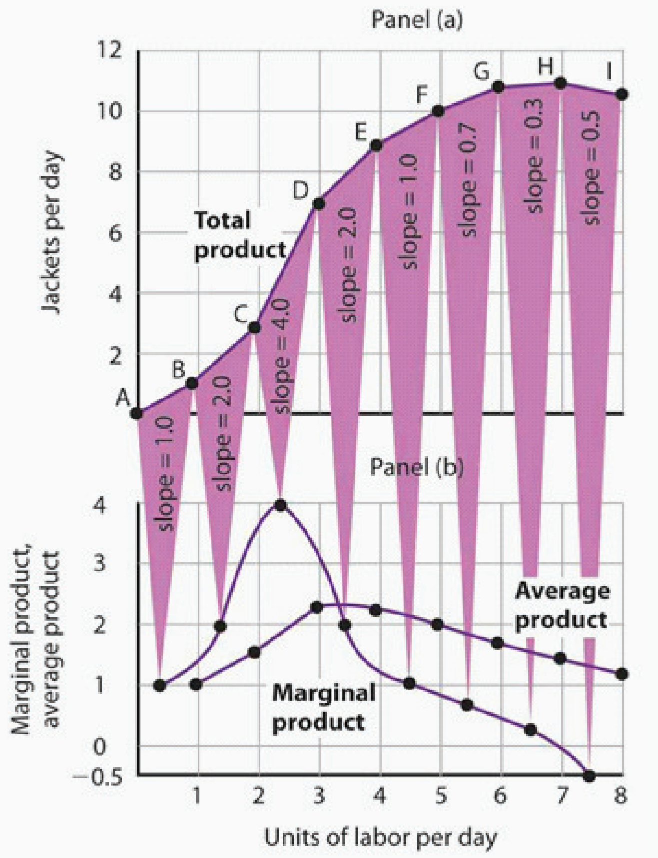


Figure 3.2 From total product to the average and marginal product of labour

The first two rows of the table give the values for quantities of labour and total product from **Figure 3.1**. *Marginal product, given in the third row, is the change in output resulting from a one-unit increase in labour. Average product, given in the fourth row, is output per unit of labour. Panel (a) shows the total product curve. The slope of the total product curve is marginal product, which is plotted in Panel (b). Values for marginal product are plotted at the midpoints of the intervals. Average product rises and falls. Where marginal product is above average product, average product rises. Where marginal product is below average product, average product falls. The marginal product curve intersects the average product curve at the maximum point on the average product curve.*

As a student you can use your own experience to understand the relationship between marginal and average values. Your grade point average (GPA) represents the average grade you have earned in all your course work so far. When you take an additional course, your grade in that course represents the marginal grade. What happens to your GPA when you get a grade that is higher than your previous average? It rises. What happens to your GPA when you get a grade that is lower than your previous average? It falls. If your GPA is a 3.0 and you earn one more B, your marginal grade equals your GPA and your GPA remains unchanged.

The relationship between average product and marginal product is similar. However, unlike your course grades, which may go up and down, marginal product always rises and then falls, for reasons we will explore shortly. As soon as marginal product falls below average product, the average product curve slopes downward. While marginal product is above average product, whether marginal product is increasing or decreasing, the average product curve slopes upward.

As we have learned, maximising behaviour requires focusing on making decisions at the margin. For this reason, we turn our attention now toward increasing our understanding of marginal product.

Increasing, diminishing and negative marginal returns

Adding the first worker increases Acme's output from 0 to 1 jacket per day. The second tailor adds 2 jackets to total output; the third adds 4. The marginal product goes up because when there are more workers, each one can specialise to a degree. One worker might cut the cloth, another might sew the seams, and another might sew the buttonholes. Their increasing marginal products are reflected by the increasing slope of the total product curve over the first 3 units of labour and by the upward slope of the marginal product curve over the same range. The range over which marginal products are increasing is called the range of increasing marginal returns. Increasing marginal returns exist in the context of a total product curve for labour, so we are holding the quantities of other factors constant. Increasing marginal returns may occur for any variable factor.

The fourth worker adds less to total output than the third; the marginal product of the fourth worker is 2 jackets. The data in **Figure 3.2** show that marginal product continues to decline after the fourth worker as more and more workers are hired. The additional workers allow even greater opportunities for specialization, but because they are operating with a fixed amount of capital, each new worker adds less to total output. The fifth tailor adds only a single jacket to total output. When each additional unit of a variable factor adds less to total output, the firm is experiencing diminishing marginal returns. Over the range of diminishing marginal returns, the marginal product of the variable factor is positive but falling. Once again, we assume that the quantities of all other factors of production are fixed. Diminishing marginal returns may occur for any variable factor. Panel (b) shows that Acme experiences diminishing marginal returns between the third and seventh workers, or between 7 and 11 jackets per day.

After the seventh unit of labour, Acme's fixed plant becomes so crowded that adding another worker actually reduces output. When additional units of a variable factor reduce total output, given constant quantities of all other factors, the company experiences negative marginal returns. Now the total product curve is downward sloping, and the marginal product curve falls below zero. **Figure 3.3** shows the ranges of increasing, diminishing, and negative marginal returns. Clearly, a firm will never intentionally add so much of a variable factor of production that it enters a range of negative marginal returns.

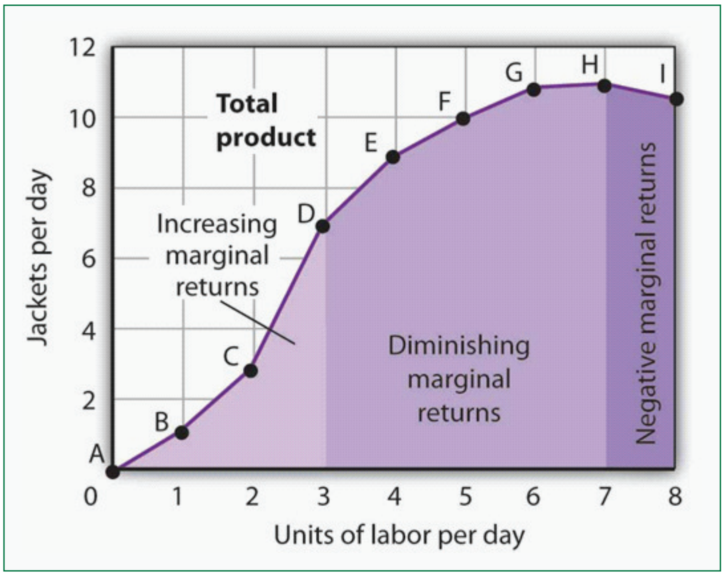


Figure 3.3 Increasing marginal returns, diminishing marginal returns and negative marginal returns

This graph shows Acme's total product curve from **Figure 3.1** *with the ranges of increasing marginal returns, diminishing marginal returns, and negative marginal returns marked. Acme experiences increasing marginal returns between 0 and 3 units of labour per day, diminishing marginal returns between 3 and 7 units of labour per day, and negative marginal returns beyond the 7th unit of labour.*

The idea that the marginal product of a variable factor declines over some range is important enough, and general enough, that economists state it as a law. The law of diminishing marginal returns holds that the marginal product of any variable factor of production will eventually decline, assuming the quantities of other factors of production are unchanged.

To see the logic of the law of diminishing marginal returns, imagine a case in which it does not hold. Say that you have a small plot of land for a vegetable garden, 10 feet by 10 feet in size. The plot itself is a fixed factor in the production of vegetables. Suppose you are able to hold constant all other factors — water, sunshine, temperature, fertilizer, and seed — and vary the amount of labour devoted to the garden. How much food could the garden produce? Suppose the marginal product of labour kept increasing or was constant. Then you could grow an unlimited quantity of food on your small plot — enough to feed the entire world! You could add an *unlimited* number of workers to your plot and still increase output at a constant or increasing rate. If you did not get enough output with, say, 500 workers, you could use 5 million; the five millionth worker would add at least as much to total output as the first. If diminishing marginal returns to labour did not occur, the total product curve would slope upward at a constant or increasing rate.

The shape of the total product curve and the shape of the resulting marginal product curve drawn in **Figure 3.2** are typical of any firm for the short run. Given its fixed factors of production, increasing the use of a variable factor will generate increasing marginal returns at first; the total product curve for the variable factor becomes steeper and the marginal product rises. The opportunity to gain from increased specialisation in the use of the variable factor accounts for this range of increasing marginal returns. Eventually, though, diminishing returns will set in. The total product curve will become flatter, and the marginal product curve will fall.

Costs in the short run

A firm's costs of production depend on the quantities and prices of its factors of production. Because we expect a firm's output to vary with the firm's use of labour in a specific way, we can also expect the firm's costs to vary with its output in a specific way. We shall put our information about Acme's product curves to work to discover how a firm's costs vary with its level of output.

We distinguish between the costs associated with the use of variable factors of production, which are called variable costs, and the costs associated with the use of fixed factors of production, which are called fixed costs. For most firms, variable costs include costs for raw materials, salaries of production workers, and utilities. The salaries of top management may be fixed costs; any charges set by contract over a period of time, such as Acme's one-year lease on its building and equipment, are likely to be fixed costs. A term commonly used for fixed costs is overhead. Notice that fixed costs exist only in the short run. In the long run, the quantities of all factors of production are variable, so that all long-run costs are variable.

Total variable cost (TVC) is cost that varies with the level of output. Total fixed cost (TFC) is cost that does not vary with output. Total cost (TC) is the sum of total variable cost and total fixed cost:

Equation 3.3

$$TVC + TFC = TC$$

From total production to total cost

Next we illustrate the relationship between Acme's total product curve and its total costs. Acme can vary the quantity of labour it uses each day, so the cost of this labour is a variable cost. We assume capital is a fixed factor of production in the short run, so its cost is a fixed cost.

Suppose that Acme pays a wage of RM100 per worker per day. If labour is the only variable factor, Acme's total variable costs per day amount to RM100 the number of workers it employs. We can use the information given by the total product curve, together with the wage, to compute Acme's total variable costs.

We know from **Figure 3.1** that Acme requires 1 worker working 1 day to produce 1 jacket. The total variable cost of a jacket thus equals RM100. Three units of labour produce 7 jackets per day; the total variable cost of 7 jackets equals RM300. **Figure 3.4** shows Acme's total variable costs for producing each of the output levels given in **Figure 3.1**.

Figure 3.4 gives us costs for several quantities of jackets, but we need a bit more detail. We know, for example, that 7 jackets have a total variable cost of RM300. What is the total variable cost of 6 jackets?

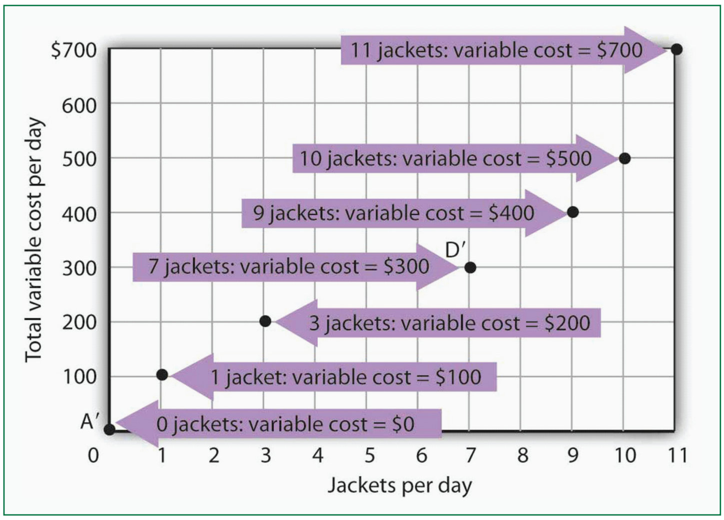


Figure 3.4 Computing variable costs

The points shown give the variable costs of producing the quantities of jackets given in the total product curve in **Figure 3.1** *and* **Figure 3.2**. *Suppose Acme's workers earn RM100 per day. If Acme produces 0 jackets, it will use no labour — its variable cost thus equals RM0 (Point A'). Producing 7 jackets requires 3 units of labour; Acme's variable cost equals RM300 (Point D').*

We can estimate total variable costs for other quantities of jackets by inspecting the total product curve in **Figure 3.1**. Reading over from a quantity of 6 jackets to the total product curve and then down suggests that the Acme needs about 2.8 units of labour to produce 6 jackets per day. Acme needs 2 full-time and 1 part-time tailors to produce 6 jackets. **Figure 3.5** gives the precise total variable costs for quantities of jackets ranging from 0 to 11 per day. The numbers in boldface type are taken from **Figure 3.4**; the other numbers are estimates we have assigned to produce a total variable cost curve that is consistent with our total product curve. You should, however, be certain that you understand how the numbers in boldface type were found.

Quantity/day	0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0
Labor/day	**0**	**1.00**	1.63	**2.00**	2.33	2.58	2.80	**3.00**	3.38	**4.00**	**5.00**	**7.00**
Total variable cost	**$0**	**$100**	$163	**$200**	$233	$258	$280	**$300**	$338	**$400**	**$500**	**$700**

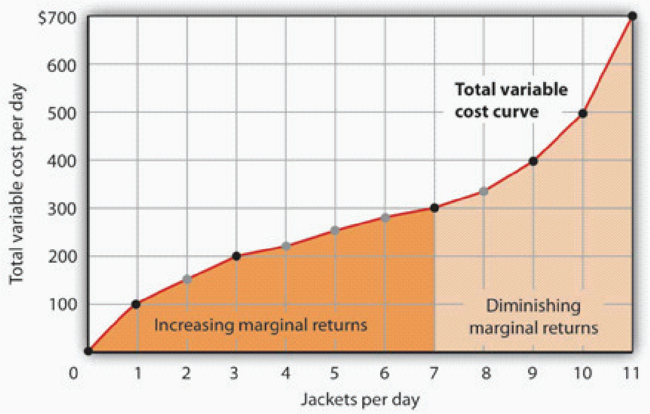


Figure 3.5 The total variable cost curve

Total variable costs for output levels shown in Acme's total product curve were shown in **Figure 3.4***. To complete the total variable cost curve, we need to know the variable cost for each level of output from 0 to 11 jackets per day. The variable costs and quantities of labour given in* **Figure 3.4** *are shown in boldface in the table here and with black dots in the graph. The remaining values were estimated from the total product curve in* **Figure 3.1** *and* **Figure 3.2***. For example, producing 6 jackets requires 2.8 workers, for a variable cost of RM280.*

Suppose Acme's present plant, including the building and equipment, is the equivalent of 20 units of capital. Acme has signed a long-term lease for these 20 units of capital at a cost of RM200 per day. In the short run, Acme cannot increase or decrease its quantity of capital — it must pay the RM200 per day no matter what it does. Even if the firm cuts production to zero, it must still pay RM200 per day in the short run.

Acme's total cost is its total fixed cost of RM200 plus its total variable cost. We add RM200 to the total variable cost curve in **Figure 3.5** to get the total cost curve shown in **Figure 3.6**.

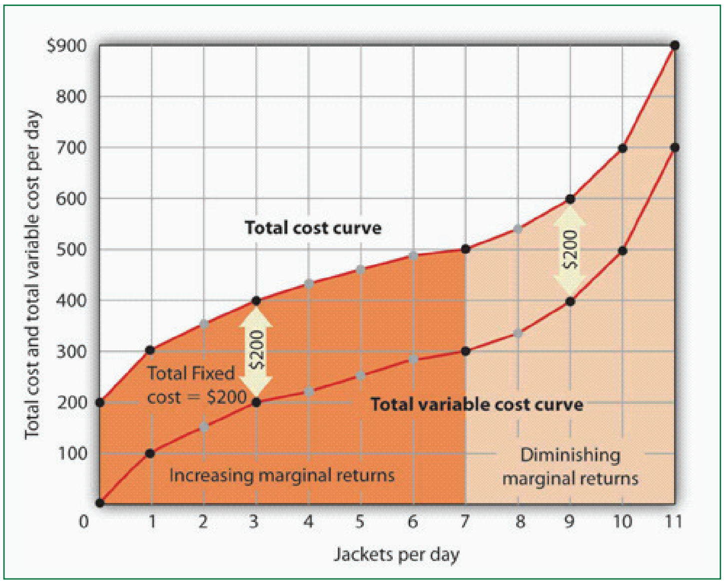


Figure 3.6 From variable cost to total cost

We add total fixed cost to the total variable cost to obtain total cost. In this case, Acme's total fixed cost equals RM200 per day.

Notice something important about the shapes of the total cost and total variable cost curves in **Figure 3.6**. The total cost curve, for example, starts at RM200 when Acme produces 0 jackets — that is its total fixed cost. The curve rises, but at a decreasing rate, up to the seventh jacket. Beyond the seventh jacket, the curve becomes steeper and steeper. The slope of the total variable cost curve behaves in precisely the same way.

Recall that Acme experienced increasing marginal returns to labour for the first three units of labour — or the first seven jackets. Up to the third worker, each additional worker added more and more to Acme's output. Over the range of increasing marginal returns, each additional jacket requires less and less additional labour. The first jacket required one tailor; the second required the addition of only a part-time tailor; the third required only that Acme boost that part-time tailor's hours to a full day. Up to the seventh jacket, each additional jacket requires less and less additional labour, and thus costs rise at a decreasing rate; the total cost and total variable cost curves become flatter over the range of increasing marginal returns.

Acme experiences diminishing marginal returns beyond the third unit of labour — or the seventh jacket. Notice that the total cost and total variable cost curves become steeper and steeper beyond this level of output. In the range of diminishing marginal returns, each additional unit of a factor adds less and less to total output. That means each additional unit of output requires larger and larger increases in the variable factor, and larger and larger increases in costs.

Marginal and average costs

Marginal and average cost curves, which will play an important role in the analysis of the firm, can be derived from the total cost curve. Marginal cost shows the additional cost of each additional unit of output a firm produces. This is a specific application of the general concept of marginal cost presented earlier. Given the marginal decision rule's focus on evaluating choices at the margin, the marginal cost curve takes on enormous importance in the analysis of a firm's choices. The second curve we shall derive shows the firm's average total cost at each level of output. Average total cost (ATC) is total cost divided by quantity; it is the firm's total cost per unit of output:

Equation 3.4

ATC = TC/Q

We shall also discuss average variable costs (*AVC*), which is the firm's variable cost per unit of output; it is total variable cost divided by quantity:

Equation 3.5

AVC = TVC/Q

We are still assessing the choices facing the firm in the short run, so we assume that at least one factor of production is fixed. Finally, we will discuss average fixed cost (*AFC*), which is total fixed cost divided by quantity:

Equation 3.6

AFC = TFC/Q

Marginal cost (*MC*) is the amount by which total cost rises with an additional unit of output. It is the ratio of the change in total cost to the change in the quantity of output:

Equation 3.7

MC = ΔTC/ΔQ

It equals the slope of the total cost curve. **Figure 3.7** shows the same total cost curve that was presented in **Figure 3.6**. This time the slopes of the total cost curve are shown; these slopes equal the marginal cost of each additional unit of output. For example, increasing output from 6 to 7 units ($\Delta Q = 1$) increases total cost from RM480 to RM500 ($\Delta TC/\Delta Q$ = RM20/1 = RM20). The seventh unit thus has a marginal cost of RM20 Marginal cost falls over the range of increasing marginal returns and rises over the range of diminishing marginal returns.

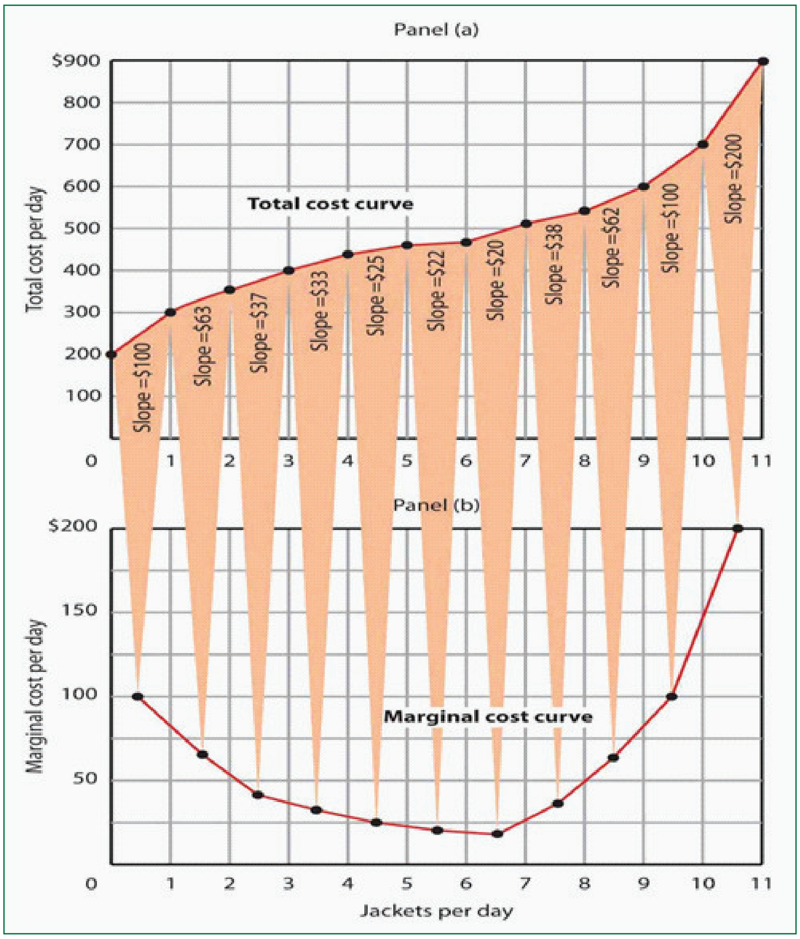


Figure 3.7 Total cost and marginal cost

Marginal cost in Panel (b) is the slope of the total cost curve in Panel (a).

Figure 3.8 shows the computation of Acme's short-run average total cost, average variable cost, and average fixed cost and graphs of these values. Notice that the curves for short-run average total cost and average variable cost fall, then rise. We say that these cost curves are U-shaped. Average fixed cost keeps falling as output increases. This is because the fixed costs are spread out more and more as output expands; by definition, they do not vary as labour is added. Since average total cost (*ATC*) is the sum of average variable cost (*AVC*) and average fixed cost (*AFC*), i.e., the distance between the *ATC* and *AVC* curves keeps getting smaller and smaller as the firm spreads its overhead costs over more and more output.

Equation 3.8

AVC + AFC = ATC

Quantity/day	0	1	2	3	4	5	6	7	8	9	10	11
Total cost	$200	$300	$363	$400	$433	$458	$480	$500	$538	$600	$700	$900
AFC		$200	$100	$67	$50	$40	$33	$29	$25	$22	$20	$18
AVC		$100	$82	$67	$58	$52	$47	$43	$42	$44	$50	$64
ATC		$300	$182	$133	$108	$92	$80	$71	$67	$67	$70	$82
MC		$100	$63	$37	$33	$25	$22	$20	$38	$62	$100	$200

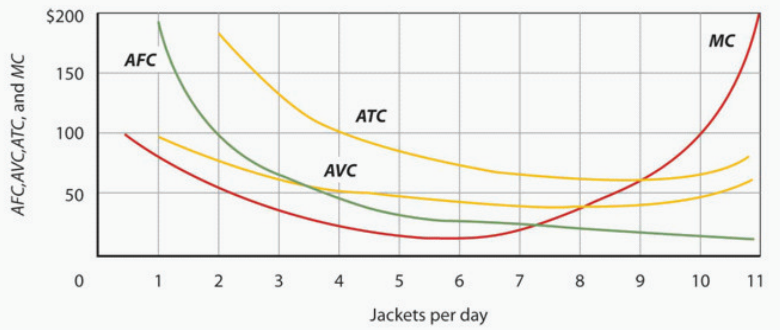


Figure 3.8 Marginal cost, average fixed cost, average variable cost and average total cost in the short run

Total cost figures for Acme Clothing are taken from **Figure 3.7**. *The other values are derived from these. Average total cost (ATC) equals total cost divided by quantity produced; it also equals the sum of the average fixed cost (AFC) and average variable cost (AVC) (exceptions in table are due to rounding to the nearest dollar); average variable cost is variable cost divided by quantity produced. The marginal cost (MC) curve (from* **Figure 3.7***) intersects the ATC and AVC curves at the lowest points on both curves. The AFC curve falls as quantity increases.*

Figure 3.8 includes the marginal cost data and the marginal cost curve from **Figure 3.7**. The marginal cost curve intersects the average total cost and average variable cost curves at their lowest points. When marginal cost is below average total cost or average variable cost, the average total and average variable cost curves slope downward. When marginal cost is greater than short-run average total cost or average variable cost, these average cost curves slope upward. The logic behind the relationship between marginal cost and average total and variable costs is the same as it is for the relationship between marginal product and average product.

In the following section, we will examine production and cost in the long run, a planning period in which the firm can consider changing the quantities of any or all factors.

Summary

In the short-run, a firm can only produce limited number of output. The limitation comes from the inability of firms to change or increase fixed inputs. Inputs like land cannot be easily manipulated to increase production.

This, in turn, creates an environment for the production process to react in a predictable manner. The production will increase and then decrease over the whole process. This is when the law of diminishing returns kicks in whereby the returns increase and then decrease over time.

This situation also pushes the display of an inverse relationship between marginal cost and the rest of the cost curves. A firm would need to move the long-run to escape from this situation.

Self-test 3.1

1. Suppose Acme gets some new equipment for producing jackets. The table below gives its new production function. Compute marginal product and average product and fill in the bottom two rows of the table. Referring to **Figure 3.2**, draw a graph showing Acme's new total product curve. On a second graph, below the one showing the total product curve you drew, sketch the marginal and average product curves. Remember to plot marginal product at the midpoint between each input level. On both graphs, shade the regions where Acme experiences increasing marginal returns, diminishing marginal returns, and negative marginal returns.

Units of Labour	Jackets (per day)	Marginal Product	Average Product
0	0		
1	2		
2	5.5		
3	9.5		
4	12		
5	14		
6	15		
7	15.5		
8	15		

Draw the points showing total variable cost at daily outputs of 0, 1, 3, 7, 9, 10, and 11 jackets per day when Acme faced a wage of RM100 per day. (Use **Figure 3.5** as a model). Sketch the total variable cost curve as shown in **Figure 3.4**. Now suppose that the wage rises to RM125 per day. On the same graph, show the new points and sketch the new total variable cost curve.

2. Explain what has happened. What will happen to Acme's marginal cost curve? Its average total, average variable and average fixed cost curves? Explain.

3.2 Production Choices and Costs: The Long Run

Objectives

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

1. Apply the marginal decision rule to explain how a firm chooses its mix of factors of production in the long run.
2. Define the long-run average cost curve and explain how it relates to economies and diseconomies or scale.

Introduction

In a long-run planning perspective, a firm can consider changing the quantities of *all* its factors of production. That gives the firm opportunities it does not have in the short run. First, the firm can select the mix of factors it wishes to use. Should it choose a production process with lots of labour and not much capital, like the street sweepers in China? Or should it select a process that uses a great deal of capital and relatively little labour, like street sweepers in the United States? The second thing the firm can select is the scale (or overall size) of its operations. In the short run, a firm can increase output only by increasing its use of a variable factor. Remember the most important variable factor is labour. But in the long run, all factors are variable, so the firm can expand the use of all of its factors of production. The question facing the firm in the long run is: How much of an expansion or contraction in the scale of its operations should it undertake? Alternatively, it could choose to go out of business.

In its long-run planning, the firm not only regards all factors as variable, but it regards all costs as variable as well. There are no fixed costs in the long run. Because all costs are variable, the structure of costs in the long run differs somewhat from what we saw in the short run.

Costs in the long run

As in the short run, costs in the long run depend on the firm's level of output, the costs of factors, and the quantities of factors needed for each level of output. The chief difference between long- and short-run costs is there are no fixed factors in the long run. There are thus no fixed costs. All costs are variable, so we do not distinguish between total variable cost and total cost in the long run: total cost is total variable cost.

The long-run average cost (LRAC) shows the firm's lowest cost per unit at each level of output, assuming that all factors of production are variable. The *LRAC* curve assumes that the firm has chosen the optimal factor mix, as described in the previous section, for producing any level of output. The costs it shows are therefore the lowest costs possible for each level of output. It is important to note, however, that this does not mean that the minimum points of each short-run ATC curves lie on the *LRAC* curve. This critical point is explained in the next paragraph and expanded upon even further in the next section.

Figure 3.9 shows how a firm's LRAC curve is derived. Suppose Lifetime Disc Co. produces compact discs (CDs) using capital and labour. We have already seen how a firm's average total cost curve can be drawn in the short run for a given quantity of a particular factor of production, such as capital. In the short run, Lifetime Disc might be limited to operating with a given amount of capital; it would face one of the short-run average total cost curves shown in **Figure 3.9**.

If it has 30 units of capital, for example, its average total cost curve is ATC30. In the long run the firm can examine the average total cost curves associated with varying levels of capital. Four possible short-run average total cost curves for Lifetime Disc are shown in **Figure 3.9** for quantities of capital of 20, 30, 40, and 50 units. The relevant curves are labelled *ATC20*, *ATC30*, *ATC40*, and *ATC50* respectively. The *LRAC* curve is derived from this set of short-run curves by finding the lowest average total cost associated with each level of output. Again, notice that the U-shaped LRAC curve is an envelope curve that surrounds the various short-run ATC curves. With the exception of *ATC*40, in this example, the lowest cost per unit for a particular level of output in the long run is not the minimum point of the relevant short-run curve.

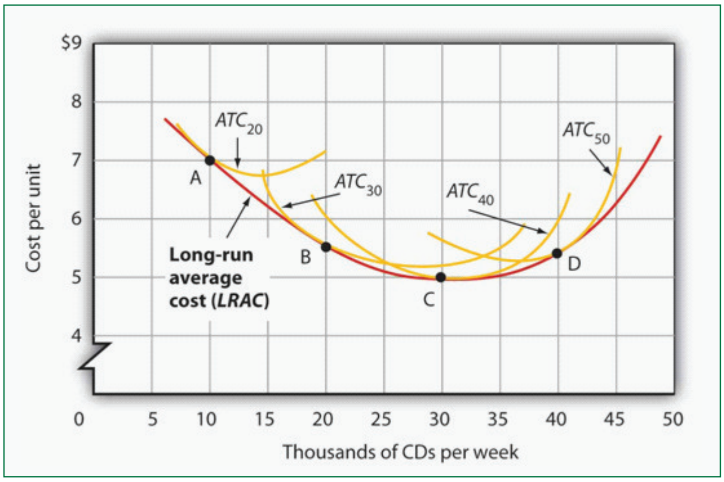


Figure 3.9 Relationship between short-run and long-run average total costs

The LRAC curve is found by taking the lowest average total cost curve at each level of output. Here, average total cost curves for quantities of capital of 20, 30, 40, and 50 units are shown for the Lifetime Disc Co. At a production level of 10,000 CDs per week, Lifetime minimises its cost per CD by producing with 20 units of capital (point A). At 20,000 CDs per week, an expansion to a plant size associated with 30 units of capital *minimises cost per unit (point B). The lowest cost per unit is achieved with production of 30,000 CDs per week using 40 units of capital (point C). If Lifetime chooses to produce 40,000 CDs per week, it will do so most cheaply with 50 units of capital (point D).*

Economies and diseconomies of scale

Notice that the long-run average cost curve in **Figure 3.9** first slopes downward and then slopes upward. The shape of this curve tells us what is happening to average cost as the firm changes its scale of operations. A firm is said to experience economies of scale when long-run average cost declines as the firm expands its output. A firm is said to experience diseconomies of scale when long-run average cost increases as the firm expands its output. Constant returns to scale occur when long-run average cost stays the same over an output range.

Why would a firm experience economies of scale? One source of economies of scale is gains from specialisation. As the scale of a firm's operation expands, it is able to use its factors in more specialised ways, increasing their productivity. Another source of economies of scale lies in the economies that can be gained from mass production methods. As the scale of a firm's operation expands, the company can begin to utilise large-scale machines and production systems that can substantially reduce cost per unit.

Why would a firm experience diseconomies of scale? At first glance, it might seem that the answer lies in the law of diminishing marginal returns, but this is not the case. The law of diminishing marginal returns, after all, tells us how output changes as a single factor is increased, with all other factors of production held constant. In contrast, diseconomies of scale describe a situation of rising average cost even when the firm is free to vary any or all of its factors as it wish. Diseconomies of scale are generally thought to be caused by management problems. As the scale of a firm's operations expands, it becomes harder and harder for management to coordinate and guide the activities of individual units of the firm. Eventually, the diseconomies of management overwhelm any gains the firm might be achieving by operating with a larger scale of plant, and long-run average costs begin rising. Firms experience constant returns to scale at output levels where there are neither economies nor diseconomies of scale. For the range of output over which the firm experiences constant returns to scale, the long-run average cost curve is horizontal.

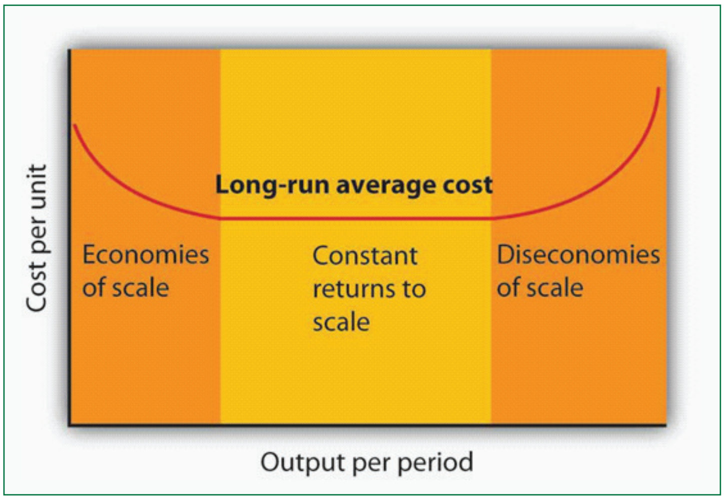


Figure 3.10 Economies and diseconomies of scale and long-run average cost

The downward-sloping region of the firm's LRAC curve is associated with economies of scale. There may be a horizontal range associated with constant returns to scale. The upward-sloping range of the curve implies diseconomies of scale.

Firms are likely to experience all three situations, as shown in **Figure 3.10**. At very low levels of output, the firm is likely to experience economies of scale as it expands the scale of its operations. There may follow a range of output over which the firm experiences constant returns to scale — empirical studies suggest that the range over which firms experience constant returns to scale is often very large. And certainly there must be some range of output over which diseconomies of scale occur; this phenomenon is one factor that limits the size of firms. A firm operating on the upward-sloping part of its *LRAC* curve is likely to be undercut in the market by smaller firms operating with lower costs per unit of output.

The size distribution of firms

Economies and diseconomies of scale have a powerful effect on the sizes of firms that will operate in any market. Suppose firms in a particular industry experience diseconomies of scale at relatively low levels of output. That industry will be characterised by a large number of fairly small firms. The restaurant market appears to be such an industry. Restaurants usually have low customer base and relatively higher costs. Barbers and beauticians are another example of firms facing similar situation. Customer loyalty plays an important role in maintaining the customer base. This does not fare well for the firms as the higher costs and lower revenue will eventually push the firms out of the market.

If firms in an industry experience economies of scale over a very wide range of output, firms that expand to take advantage of lower cost will force out smaller firms that have higher costs. Such industries are likely to have a few large firms instead of many small ones. In the refrigerator industry, for example, the size of firm necessary to achieve the lowest possible cost per unit is large enough to limit the market to only a few firms. For example, if economies of scale are experienced by the newspaper industry, eventually there will be room for only a single (or a few) newspaper(s).

One factor that can limit the achievement of economies of scale is the demand facing an individual firm. The scale of output required to achieve the lowest unit costs possible may require sales that exceed the demand facing a firm. A grocery store, for example, could minimise unit costs with a large store and a large volume of sales. But the demand for groceries in a small, isolated community may not be able to sustain such a volume of sales. The firm is thus limited to a small scale of operation even though this might involve higher unit costs.

Summary

In the long run, all variables can be manipulated to change or increase the production. However, this also brings with it cost implications as the production cost will escalate. In the long -run, firms experience economies of scale which lowers the average cost of production. As the size of firms increase, the marginal increase in costs can be minimised as opposed to the increase in the output.

Self-test 3.2

1. Suppose Acme Clothing is operating with 20 units of capital and producing 9 units of output at an average total cost of RM67, as shown in **Figure 3.8**. How much labour is it using?

2. Suppose it finds that, with this combination of capital and labour, $MP_K/P_K > MP_L/P_L$. What adjustment will the firm make in the long run? Why does it not make this same adjustment in the short run?

3.3 Perfect Competition: A Model

Objectives

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

1. Explain the characteristics of perfect competition.
2. Identify output determination in the short run.
3. Discuss marginal revenue, price and demand for the firm.
4. Differentiate the economic and accounting concepts of profit and loss.
5. Identify the basic assumptions of the model of perfect competition and explain why they imply price-taking behaviour.

Introduction

Virtually all firms in a market economy face competition from other firms. In this section, we will be working with a model of a highly idealised form of competition called "perfect" by economists.

Perfect competition is a model of the market based on the assumption that a large number of firms produce identical goods consumed by a large number of buyers. The model of perfect competition also assumes that it is easy for new firms to enter the market and for existing ones to leave. And finally, it assumes that buyers and sellers have complete information about market conditions.

As we examine these assumptions in greater detail, we will see that they allow us to work with the model more easily. No market fully meets the conditions set out in these assumptions. As is always the case with models, our purpose is to understand the way things work, not to describe them. And the model of perfect competition will prove enormously useful in understanding the world of markets.

Assumptions of the model

The assumptions of the model of perfect competition, taken together, imply that individual buyers and sellers in a perfectly competitive market accept the market price as given. No one buyer or seller has any influence over that price. Individuals or firms who must take the market price as given are called price takers. A consumer or firm that takes the market price as given has no ability to influence that price. A price-taking firm or consumer is like an individual who is buying or selling stocks. He or she looks up the market price and buys or sells at that price. The price is determined by demand and supply in the market — not by individual buyers or sellers. In a perfectly competitive market, each firm and each consumer is a price taker. A price-taking consumer assumes that he or she can purchase any quantity at the market price — without affecting that price. Similarly, a price-taking firm assumes it can sell whatever quantity it wishes at the market price without affecting the price.

You are a price taker when you go into a store. You observe the prices listed and make a choice to buy or not. Your choice will not affect that price. Should you sell a textbook back to your campus bookstore at the end of a course, you are a price-taking seller. You are confronted by a market price and you decide whether to sell or not. Your decision will not affect that price.

To see how the assumptions of the model of perfect competition imply price-taking behaviour, let us examine each of them in turn.

Identical goods

In a perfectly competitive market for a good or service, one unit of the good or service cannot be differentiated from any other on any basis. A bushel of, say, hard winter wheat is an example. A bushel produced by one farmer is identical to that produced by another. There are no brand preferences or consumer loyalties.

The assumption that goods are identical is necessary if firms are to be price takers. If one farmer's wheat were perceived as having special properties that distinguished it from other wheat, then that farmer would have some power over its price. By assuming that all goods and services produced by firms in a perfectly competitive market are identical, we establish a necessary condition for price-taking behaviour. Economists sometimes say that the goods or services in a perfectly competitive market are *homogeneous*, meaning that they are all alike. There are no brand differences in a perfectly competitive market.

A large number of buyers and sellers

How many buyers and sellers are in our market? The answer rests on our presumption of price-taking behaviour. There are so many buyers and sellers that none of them has any influence on the market price regardless of how much any of them purchases or sells. A firm in a perfectly competitive market can react to prices, but cannot affect the prices it pays for the factors of production or the prices it receives for its output.

Ease of entry and exit

The assumption that it is easy for other firms to enter a perfectly competitive market implies an even greater degree of competition. Firms in a market must deal not only with the large number of competing firms but also with the possibility that still more firms might enter the market.

Later in this unit, we will see how ease of entry is related to the sustainability of economic profits. If entry is easy, then the promise of high economic profits will quickly attract new firms. If entry is difficult, it won't.

The model of perfect competition assumes easy exit as well as easy entry. The assumption of easy exit strengthens the assumption of easy entry. Suppose a firm is considering entering a particular market. Entry may be easy, but suppose that getting out is difficult. For example, suppliers of factors of production to firms in the industry might be happy to accommodate new firms but might require that they sign long-term contracts. Such contracts could make leaving the market difficult and costly. If that were the case, a firm might be hesitant to enter in the first place. Easy exit helps make entry easier.

Complete information

We assume that all sellers have complete information about prices, technology, and all other knowledge relevant to the operation of the market. No one seller has any information about production methods that is not available to all other sellers. If one seller had an advantage over other sellers, perhaps special information about a lower-cost production method, then that seller could exert some control over market price — the seller would no longer be a price taker.

We assume also that buyers know the prices offered by every seller. If buyers did not know about prices offered by different firms in the market, then a firm might be able to sell a good or service for a price other than the market price and thus could avoid being a price taker.

The availability of information that is assumed in the model of perfect competition implies that information can be obtained at low cost. If consumers and firms can obtain information at low cost, they are likely to do so. Information about the marketplace may come over the internet, over the airways in a television commercial, or over a cup of coffee with a friend. Whatever its source, we assume that its low cost ensures that consumers and firms have enough of it so that everyone buys or sells goods and services at market prices determined by the intersection of demand and supply curves.

The assumptions of the perfectly competitive model ensure that each buyer or seller is a price taker. The market, not individual consumers or firms, determines price in the model of perfect competition. No individual has enough power in a perfectly competitive market to have any impact on that price.

Perfect competition and the real world

The assumptions of identical products, a large number of buyers, easy entry and exit, and perfect information are strong assumptions. The notion that firms must sit back and let the market determine price seems to fly in the face of what we know about most real firms, which is that firms customarily do set prices. Yet this is the basis for the model of demand and supply, the power of which you have already seen.

When we use the model of demand and supply, we assume that market forces determine prices. In this model, buyers and sellers respond to the market price. They are price takers. The assumptions of the model of perfect competition underlie the assumption of price-taking behaviour. Thus we are using the model of perfect competition whenever we apply the model of demand and supply.

We can understand most markets by applying the model of demand and supply. Even though those markets do not fulfil all the assumptions of the model of perfect competition, the model allows us to understand some key features of these markets.

Changes within your lifetime have made many markets more competitive. Falling costs of transportation, together with dramatic advances in telecommunications, have opened the possibility of entering markets to firms all over the world. A company in South Korea can compete in the market for steel in the United States. A furniture maker in New Mexico can compete in the market for furniture in Japan. A firm can enter the world market simply by creating a web page to advertise its products and to take orders. In the remaining sections of this unit, we will learn more about the response of firms to market prices. We will see how firms respond, in the short run and in the long run, to changes in demand and to changes in production costs. In short, we will be examining the forces that constitute the supply side of the model of demand and supply.

We will also see how competitive markets work to serve consumer interests and how competition acts to push economic profits down, sometimes eliminating them entirely. When we have finished we will have a better understanding of the market conditions facing farmers and of the conditions that prevail in any competitive industry.

Output determination in the short run

Our goal in this section is to see how a firm in a perfectly competitive market determines its output level in the short run — a planning period in which at least one factor of production is fixed in quantity. We shall see that the firm can maximise economic profit by applying the marginal decision rule and increasing output up to the point at which the marginal benefit of an additional unit of output is just equal to the marginal cost. This fact has an important implication: over a wide range of output, the firm's marginal cost curve is its supply curve.

Price and revenue

Each firm in a perfectly competitive market is a price taker; the equilibrium price and industry output are determined by demand and supply. **Figure 3.11** shows how demand and supply in the market for radishes, which we shall assume are produced under conditions of perfect competition, determine total output and price. The equilibrium price is RM0.40 per pound; the equilibrium quantity is 10 million pounds per month.

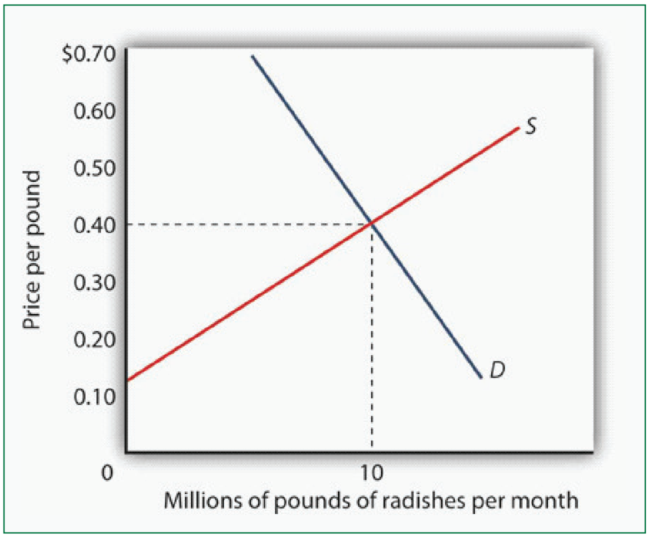


Figure 3.11 The market for radishes

Because it is a price taker, each firm in the radish industry assumes it can sell all the radishes it wants at a price of RM0.40 per pound. No matter how many or how few radishes it produces, the firm expects to sell them all at the market price.

The assumption that the firm expects to sell all the radishes it wants at the market price is crucial. If a firm did not expect to sell all of its radishes at the market price — if it had to lower the price to sell some quantities — the firm would not be a price taker. And price-taking behaviour is central to the model of perfect competition.

Radish growers — and perfectly competitive firms in general — have no reason to charge a price lower than the market price. Because buyers have complete information and because we assume each firm's product is identical to that of its rivals, firms are unable to charge a price higher than the market price. For perfectly competitive firms, the price is very much like the weather: they may complain about it, but in perfect competition there is nothing any of them can do about it.

Total revenue

While a firm in a perfectly competitive market has no influence over its price, it does determine the output it will produce. In selecting the quantity of that output, one important consideration is the revenue the firm will gain by producing it.

A firm's total revenue is found by multiplying its output by the price at which it sells that output. For a perfectly competitive firm, total revenue (*TR*) is the market price (*P*) times the quantity the firm produces (*Q*), or

Equation 3.8

$$TR = P \times Q$$

The relationship between market price and the firm's total revenue curve is a crucial one. Panel (a) of **Figure 3.12** shows total revenue curves for a radish grower at three possible market prices: RM0.20, RM0.40, and RM0.60 per pound. Each total revenue curve is a linear, upward-sloping curve. At any price, the greater the quantity a perfectly competitive firm sells, the greater its total revenue. Notice that the greater the price, the steeper the total revenue curve is.

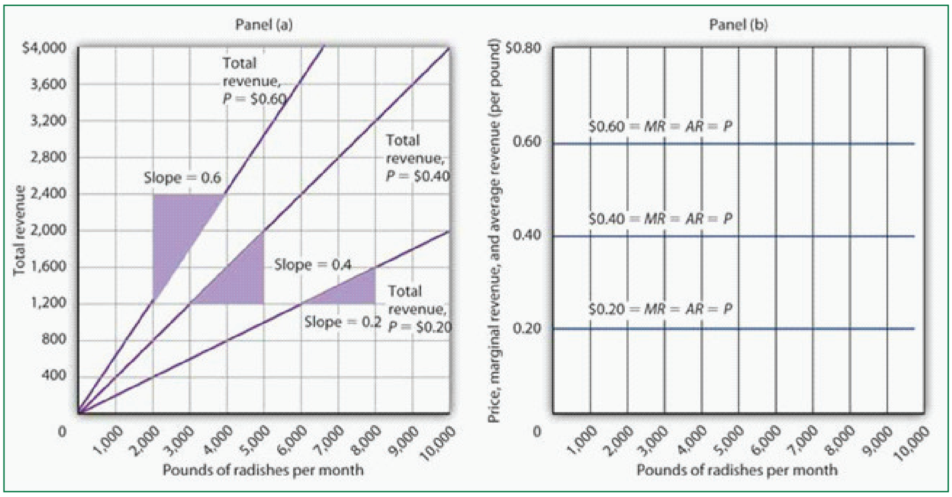


Figure 3.12 Total revenue, marginal revenue and average revenue

Panel (a) shows different total revenue curves for three possible market prices in perfect competition. A total revenue curve is a straight line coming out of the origin. The slope of a total revenue curve is MR; it equals the market price (P) and AR in perfect competition. Marginal revenue and average revenue are thus a single horizontal line at the market price, as shown in Panel (b). There is a different marginal revenue curve for each price.

Price, marginal revenue and average revenue

The slope of a total revenue curve is particularly important. It equals the change in the vertical axis (total revenue) divided by the change in the horizontal axis (quantity) between any two points. The slope measures the rate at which total revenue increases as output increases. We can think of it as the increase in total revenue associated with a 1-unit increase in output. The increase in total revenue from a 1-unit increase in quantity is marginal revenue. Thus marginal revenue (*MR*) equals the slope of the total revenue curve.

How much additional revenue does a radish producer gain from selling one more pound of radishes? The answer, of course, is the market price for 1 pound. Marginal revenue equals the market price. Because the market price is not affected by the output choice of a single firm, the marginal revenue the firm gains by producing one more unit is always the market price. The marginal revenue curve shows the relationship between marginal revenue and the quantity a firm produces. For a perfectly competitive firm, the marginal revenue curve is a horizontal line at the market price. If the market price of a pound of radishes is RM0.40, then the marginal revenue is RM0.40. Marginal revenue curves for prices of RM0.20, RM0.40, and RM0.60 are given in Panel (b) of **Figure 3.12**. In perfect competition, a firm's marginal revenue curve is a horizontal line at the market price. Price also equals average revenue, which is total revenue divided by quantity. Equation 3.8 gives total revenue, *TR*. To obtain average revenue (*AR*), we divide total revenue by quantity, *Q*. Because total revenue equals price (*P*) times quantity (*Q*), dividing by quantity leaves us with price.

Equation 3.9

$$AR = TR/Q = (P \times Q)/Q = P$$

The marginal revenue curve is a horizontal line at the market price, and average revenue equals the market price. The average and marginal revenue curves are given by the same horizontal line. This is consistent with what we have learned about the relationship between marginal and average values. When the marginal value exceeds the average value, the average value will be rising. When the marginal value is less than the average value, the average value will be falling. What happens when the average and marginal values do not change, as in the horizontal curves of Panel (b) of **Figure 3.12**? The marginal value must equal the average value; the two curves coincide.

Marginal revenue, price and demand for the perfectly competitive firm

We have seen that a perfectly competitive firm's marginal revenue curve is simply a horizontal line at the market price and that the same line is also the firm's average revenue curve. For the perfectly competitive firm, MR = P = AR. The marginal revenue curve has another meaning as well. It is the demand curve facing a perfectly competitive firm.

Consider the case of a single radish producer, Tony. We assume that the radish market is perfectly competitive; Tony runs a perfectly competitive firm. Suppose the market price of radishes is RM0.40 per pound. How many pounds of radishes can Tony sell at this price? The answer comes from our assumption that he is a price taker: He can sell any quantity he wishes at this price. How many pounds of radishes will he sell if he charges a price that exceeds the market price? None. His radishes are identical to those of every other firm in the market, and everyone in the market has complete information. That means the demand curve facing Tony is a horizontal line at the market price as illustrated in **Figure 3.13**. Notice that the curve is labelled d to distinguish it from the market demand curve, *D*, in **Figure 3.11**. The horizontal line in **Figure 3.13** is also Tony's marginal revenue curve, MR, and his average revenue curve, *AR*. It is also the market price, *P*.

Of course, Tony could charge a price below the market price, but why would he? We assume he can sell all the radishes he wants at the market price; there would be no reason to charge a lower price. Tony faces a demand curve that is a horizontal line at the market price. In our subsequent analysis, we shall refer to the horizontal line at the market price simply as marginal revenue. We should remember, however, that this same line gives us the market price, average revenue, and the demand curve facing the firm.

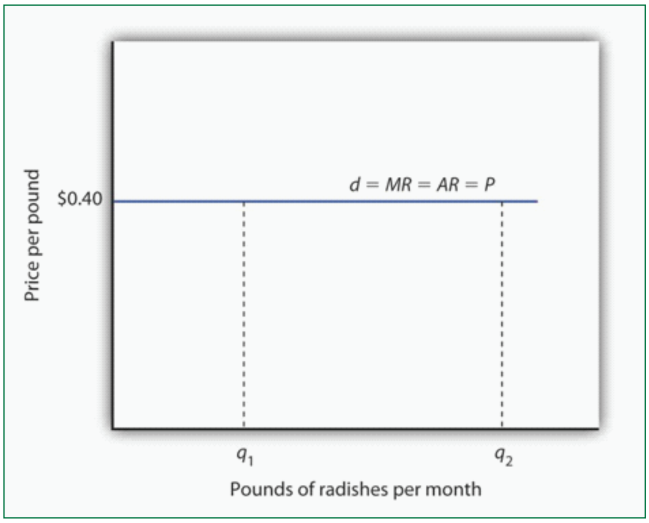


Figure 3.13 Price, marginal revenue and demand

A perfectly competitive firm faces a horizontal demand curve at the market price. Here, radish grower Tony faces demand curve d at the market price of RM0.40 per pound. He could sell q_1 *or* q_2 *— or any other quantity — at a price of RM0.40 per pound.*

More generally, we can say that any perfectly competitive firm faces a horizontal demand curve at the market price. We saw an example of a horizontal demand curve in section 2.3 on elasticity. Such a curve is perfectly elastic, meaning that any quantity is demanded at a given price.

Economic profit in the short run

A firm's economic profit is the difference between total revenue and total cost. Recall that total cost is the opportunity cost of producing a certain good or service. When we speak of economic profit we are speaking of a firm's total revenue less the total opportunity cost of its operations.

As we learnt, a firm's total cost curve in the short run intersects the vertical axis at some positive value equal to the firm's total fixed costs. Total cost then rises at a decreasing rate over the range of increasing marginal returns to the firm's variable factors. It rises at an increasing rate over the range of diminishing marginal returns. **Figure 3.14** shows the total cost curve for Tony, as well as the total revenue curve for a price of RM0.40 per pound. Suppose that his total fixed cost is RM400 per month. For any given level of output, Tony's economic profit is the vertical distance between the total revenue curve and the total cost curve at that level.

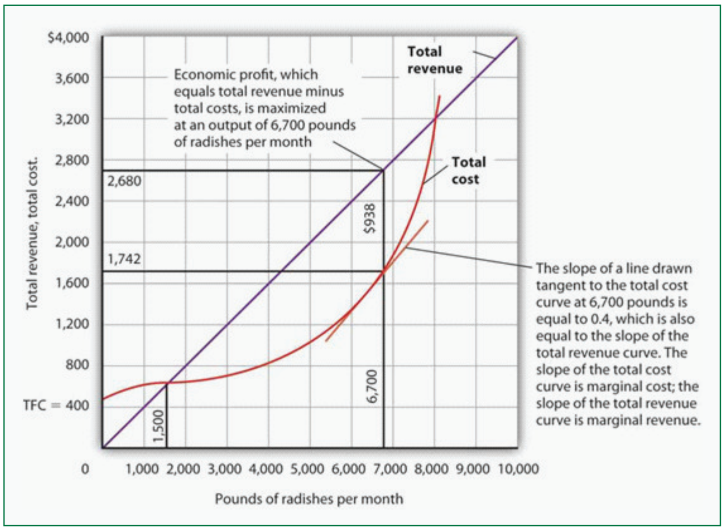


Figure 3.14 Total revenue, total cost and economic profit

Economic profit is the vertical distance between the total revenue and total cost curves (revenue minus costs). Here, the maximum profit attainable by Tony for his radish production is RM938 per month at an output of 6,700 pounds.

Let us examine the total revenue and total cost curves in **Figure 3.14** more carefully. At zero units of output, Tony's total cost is RM400 (his total fixed cost); total revenue is zero. Total cost continues to exceed total revenue up to an output of 1,500 pounds per month, at which point the two curves intersect. At this point, economic profit equals zero. As Tony expands output above 1,500 pounds per month, total revenue becomes greater than total cost. We see that at a quantity of 1,500 pounds per month, the total revenue curve is steeper than the total cost curve. Because revenues are rising faster than costs, profits rise with increased output. As long as the total revenue curve is steeper than the total cost curve, profit increases as the firm increases its output. The total revenue curve's slope does not change as the firm increases its output. But the total cost curve becomes steeper and steeper as diminishing marginal returns set in. Eventually, the total cost and total revenue curves will have the same slope. That happens in **Figure 3.14** at an output of 6,700 pounds of radishes per month. Notice that a line drawn tangent to the total cost curve at that quantity has the same slope as the total revenue curve.

As output increases beyond 6,700 pounds, the total cost curve continues to become steeper. It becomes steeper than the total revenue curve, and profits fall as costs rise faster than revenues. At an output slightly above 8,000 pounds per month, the total revenue and cost curves intersect again, and economic profit equals zero. Tony achieves the greatest profit possible by producing 6,700 pounds of radishes per month, the quantity at which the total cost and total revenue curves have the same slope. More generally, we can conclude that a perfectly competitive firm maximises economic profit at the output level at which the total revenue curve and the total cost curve have the same slope.

Applying the marginal decision rule

The slope of the total revenue curve is marginal revenue; the slope of the total cost curve is marginal cost. Economic profit, the difference between total revenue and total cost, is maximised where marginal revenue equals marginal cost. This is consistent with the marginal decision rule, which holds that a profit maximising firm should increase output until the marginal benefit of an additional unit equals the marginal cost. The marginal benefit of selling an additional unit is measured as marginal revenue. Finding the output at which marginal revenue equals marginal cost is thus an application of our marginal decision rule.

Figure 3.15 shows how a firm can use the marginal decision rule to determine its profit-maximising output. Panel (a) shows the market for radishes; the market demand curve (*D*), and supply curve (*S*) that we had in **Figure 3.11**; the market price is RM0.40 per pound. In Panel (b), the *MR* curve is given by a horizontal line at the market price. The firm's marginal cost curve (*MC*) intersects the marginal revenue curve at the point where profit is maximised. Tony maximises profits by producing 6,700 pounds of radishes per month. That is, of course, the result we obtained in **Figure 3.14**, where we saw that the firm's total revenue and total cost curves differ by the greatest amount at the point at which the slopes of the curves, which equal marginal revenue and marginal cost, respectively, are equal.

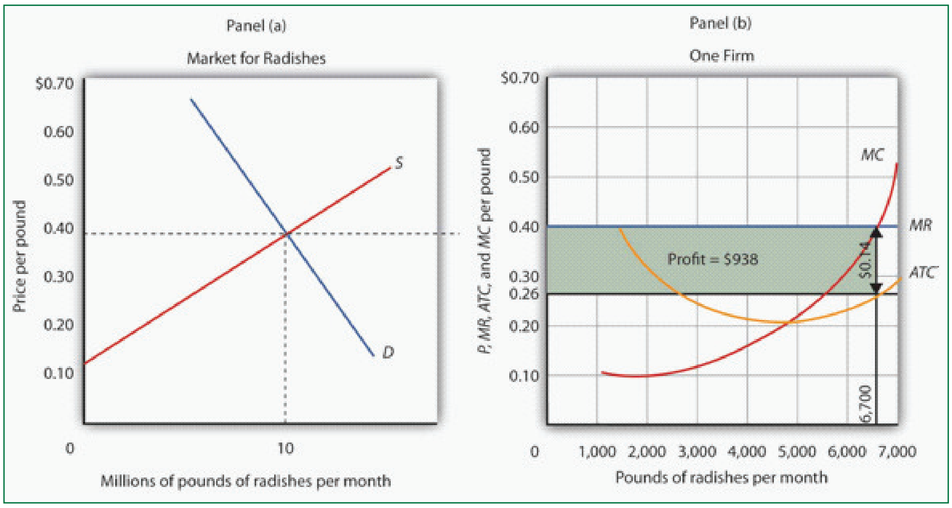


Figure 3.15 Applying the marginal decision rule

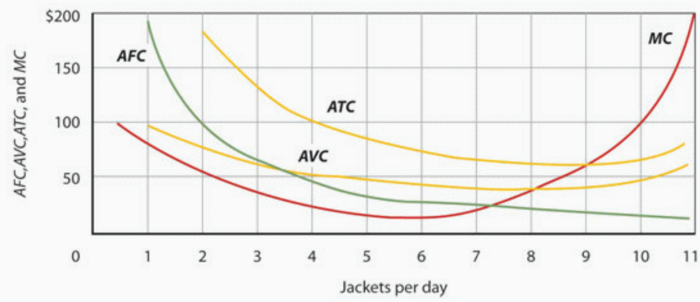
The market price is determined by the intersection of demand and supply. As always, the firm maximises profit by applying the marginal decision rule. It takes the market price, RM0.40 per pound, as given and selects an output at which MR equals MC. Economic profit per unit is the difference between ATC and price (here, RM0.14 per pound); economic profit is profit per unit times the quantity produced (RM0.14 × 6,700 = RM938).

We can use the graph in **Figure 3.15** to compute Tony's economic profit. Economic profit per unit is the difference between price and average total cost. At the profit-maximising output of 6,700 pounds of radishes per month, average total cost (*ATC*) is RM0.26 per pound, as shown in Panel (b). Price is RM0.40 per pound, so economic profit per unit is RM0.14. Economic profit is found by multiplying economic profit per unit by the number of units produced; the firm's economic profit is thus RM938 (RM0.14 × 6,700). It is shown graphically by the area of the shaded rectangle in Panel (b); this area equals the vertical distance between marginal revenue (*MR*) and average total cost (*ATC*) at an output of 6,700 pounds of radishes times the number of pounds of radishes produced, 6,700, in **Figure 3.15**.

Self-test 3.3

1. Assume that Acme Clothing, the firm introduced in this unit on production and cost, produces jackets in a perfectly competitive market. Suppose the demand and supply curves for jackets intersect at a price of RM81. Now, using the marginal cost and average total cost curves for Acme shown here:

Quantity/day	0	1	2	3	4	5	6	7	8	9	10	11
Total cost	$200	$300	$363	$400	$433	$458	$480	$500	$538	$600	$700	$900
AFC		$200	$100	$67	$50	$40	$33	$29	$25	$22	$20	$18
AVC		$100	$82	$67	$58	$52	$47	$43	$42	$44	$50	$64
ATC		$300	$182	$133	$108	$92	$80	$71	$67	$67	$70	$82
MC		$100	$63	$37	$33	$25	$22	$20	$38	$62	$100	$200



Estimate Acme's profit-maximising output per day (assume the firm selects a whole number). What are Acme's economic profits per day?

Economic losses in the short run

In the short run, a firm has one or more inputs whose quantities are fixed. That means in the short run the firm cannot leave its industry. Even if it cannot cover all of its costs, including both its variable and fixed costs, going entirely out of business is not an option in the short run. The firm may close its doors, but it must continue to pay its fixed costs. It is forced to accept an economic loss, the amount by which its total cost exceeds its total revenue.

Suppose, for example, that a manufacturer has signed a 1-year lease on some equipment. It must make payments for this equipment during the term of its lease, whether it produces anything or not. During the period of the lease, the payments represent a fixed cost for the firm.

A firm that is experiencing economic losses — whose economic profits have become negative — in the short run may either continue to produce or shut down its operations, reducing its output to zero. It will choose the option that minimises its losses. The crucial test of whether to operate or shut down lies in the relationship between price and average variable cost.

Producing to minimise economic loss

Suppose the demand for radishes falls to *D*2, as shown in Panel (a) of **Figure 3.16**. The market price for radishes plunges to RM0.18 per pound, which is below average total cost. Consequently Tony experiences negative economic profits — a loss. Although the new market price falls short of average total cost, it still exceeds average variable cost, shown in Panel (b) as *AVC*. Therefore, Tony should continue to produce an output at which marginal cost equals marginal revenue. These curves (labelled *MC* and *MR*2) intersect in Panel (b) at an output of 4,444 pounds of radishes per month.

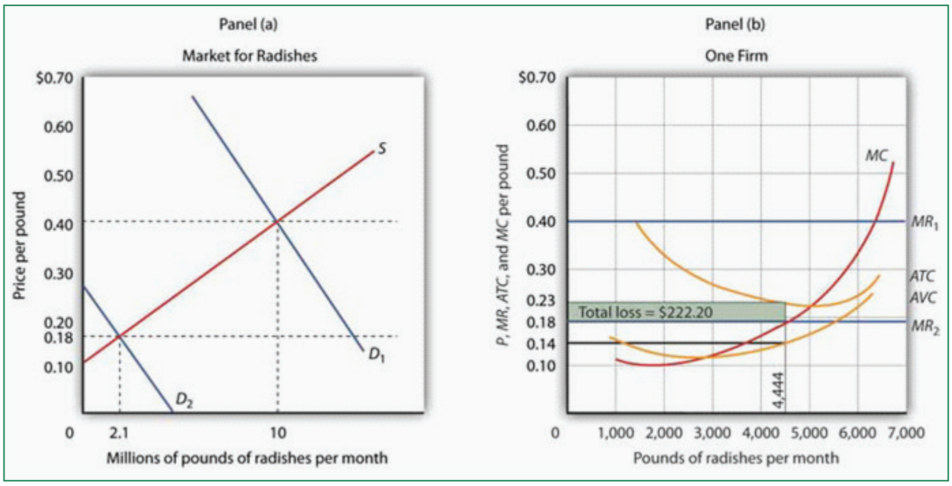


Figure 3.16 Suffering economic losses in the short run

Tony experiences a loss when price drops below ATC, as it does in Panel (b) as a result of a reduction in demand. If price is above AVC, however, he can minimise his losses by producing where MC equals MR2. Here, that occurs at an output of 4,444 pounds of radishes per month. The price is RM0.18 per pound, and average total cost is RM0.23 per pound. He loses RM0.05 per pound, or RM222.20 per month.

When producing 4,444 pounds of radishes per month, Tony faces an average total cost of RM0.23 per pound. At a price of RM0.18 per pound, he loses a nickel on each pound produced. Total economic losses at an output of 4,444 pounds per month are thus RM222.20 per month (=4,444 × RM0.05).

No producer likes a loss (that is, negative economic profit), but the loss solution shown in **Figure 3.16** is the best Tony can attain. Any level of production other than the one at which marginal cost equals marginal revenue would produce even greater losses. Suppose Tony were to shut down and produce no radishes. Ceasing production would reduce variable costs to zero, but he would still face fixed costs of RM400 per month (recall that RM400 was the vertical intercept of the total cost curve in **Figure 3.14**). By shutting down, Tony would lose RM400 per month. By continuing to produce, he loses only RM222.20.

Tony is better off producing where marginal cost equals marginal revenue because at that output price exceeds average variable cost. Average variable cost is RM0.14 per pound, so by continuing to produce he covers his variable costs, with RM0.04 per pound left over to apply to fixed costs. Whenever price is greater than average variable cost, the firm maximises economic profit (or minimises economic loss) by producing the output level at which marginal revenue and marginal cost curves intersect.

Shutting down to minimise economic loss

Suppose price drops below a firm's average variable cost. Now the best strategy for the firm is to shut down, reducing its output to zero. The minimum level of average variable cost, which occurs at the intersection of the marginal cost curve and the average variable cost curve, is called the shutdown point. Any price below the minimum value of average variable cost will cause the firm to shut down. If the firm were to continue producing, not only would it lose its fixed costs, but it would also face an additional loss by not covering its variable costs.

Figure 3.17 shows a case where the price of radishes drops to RM0.10 per pound. Price is less than average variable cost, so Tony not only would lose his fixed cost but would also incur additional losses by producing. Suppose, he decided to operate where marginal cost equals marginal revenue, producing 1,700 pounds of radishes per month. Average variable cost equals RM0.14 per pound, so he would lose RM0.04 on each pound he produces (RM68) plus his fixed cost of RM400 per month. He would lose RM468 per month. If he shut down, he would lose only his fixed cost. Because the price of RM0.10 falls below his average variable cost, his best course would be to shut down.

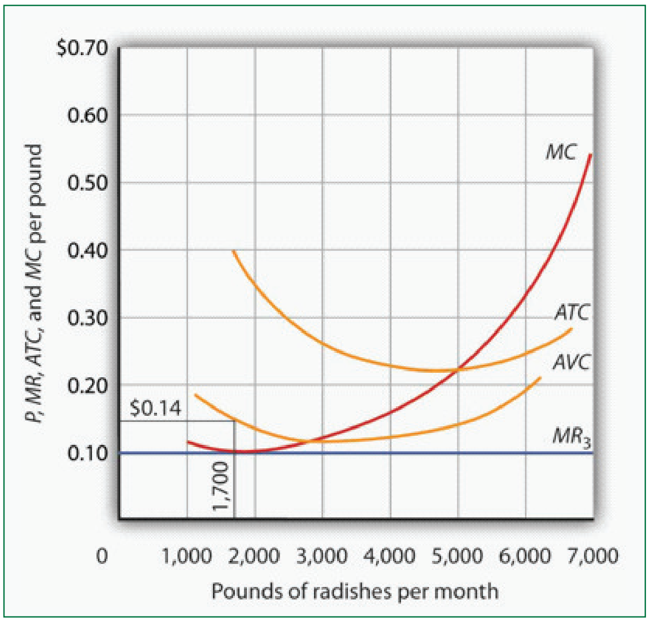


Figure 3.17 Shutting down

The market price of radishes drops to RM0.10 per pound, so MR3 is below Tony's AVC. Thus he would suffer a greater loss by continuing to operate than by shutting down. Whenever price falls below average variable cost, the firm will shut down, reducing its production to zero.

Shutting down is not the same thing as going out of business. A firm shuts down by closing its doors; it can reopen them whenever it expects to cover its variable costs. We can even think of a firm's decision to close at the end of the day as a kind of shutdown point; the firm makes this choice because it does not anticipate that it will be able to cover its variable cost overnight. It expects to cover those costs the next morning when it reopens its doors.

Marginal cost and supply

In the model of perfect competition, we assume that a firm determines its output by finding the point where the marginal revenue and marginal cost curves intersect. Provided that price exceeds average variable cost, the firm produces the quantity determined by the intersection of the two curves.

A supply curve tells us the quantity that will be produced at each price, and that is what the firm's marginal cost curve tells us. The firm's supply curve in the short run is its marginal cost curve for prices above the average variable cost. At prices below average variable cost, the firm's output drops to zero. Panel (a) of **Figure 3.18** shows the average variable cost and marginal cost curves for a hypothetical astrologer, Pak Belalang, who is in the business of providing astrological consultations over the telephone. We shall assume that this industry is perfectly competitive. At any price below RM10 per call, Pak Belalang would shut down. If the price is RM10 or greater, however, she produces an output at which price equals marginal cost. The marginal cost curve is thus her supply curve at all prices greater than RM10.

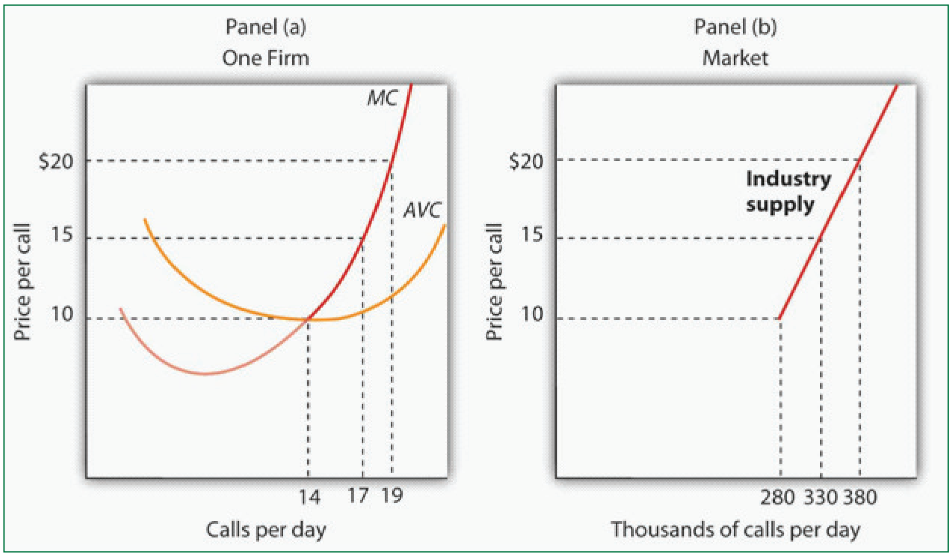


Figure 3.18 Marginal cost and supply

The supply curve for a firm is that portion of its MC curve that lies above the AVC curve, shown in Panel (a). To obtain the short-run supply curve for the industry, we add the outputs of each firm at each price. The industry supply curve is given in Panel (b).

Now suppose that the astrological forecast industry consists of Pak Belalang and thousands of other firms similar to his. The market supply curve is found by adding the outputs of each firm at each price, as shown in Panel (b) of **Figure 3.18**. At a price of RM10 per call, for example, Pak Belalang supplies 14 calls per day. Adding the quantities supplied by all the other firms in the market, suppose we get a quantity supplied of 280,000. Notice that the market supply curve we have drawn is linear; throughout this course we have made the assumption that market demand and supply curves are linear in order to simplify our analysis.

Looking at **Figure 3.18**, we see that profit-maximising choices by firms in a perfectly competitive market will generate a market supply curve that reflects marginal cost. Provided there are no external benefits or costs in producing a good or service, a perfectly competitive market satisfies the efficiency condition.

Perfect competition in the long run

In the long run, a firm is free to adjust all of its inputs. New firms can enter any market; existing firms can leave their markets. We shall see in this section that the model of perfect competition predicts that, at a long-run equilibrium, production takes place at the lowest possible cost per unit and that all economic profits and losses are eliminated.

Economic profit and economic loss

Economic profits and losses play a crucial role in the model of perfect competition. The existence of economic profits in a particular industry attracts new firms to the industry in the long run. As new firms enter, the supply curve shifts to the right, price falls, and profits fall. Firms continue to enter the industry until economic profits fall to zero. If firms in an industry are experiencing economic losses, some will leave. The supply curve shifts to the left, increasing price and reducing losses. Firms continue to leave until the remaining firms are no longer suffering losses — until economic profits are zero. Before examining the mechanism through which entry and exit eliminate economic profits and losses, we shall examine an important key to understanding it: the difference between the accounting and economic concepts of profit and loss.

Economic versus accounting concepts of profit and loss

Economic profit equals total revenue minus total cost, where cost is measured in the economic sense as opportunity cost. An economic loss (negative economic profit) is incurred if total cost exceeds total revenue. Accountants include only explicit costs in their computation of total cost. Explicit costs include charges that must be paid for factors of production such as labour and capital, together with an estimate of depreciation. Profit computed using only explicit costs is called accounting profit. It is the measure of profit firms typically report; firms pay taxes on their accounting profits, and a corporation reporting its profit for a particular period reports its accounting profits. To compute his accounting profits, Tony, the radish farmer, would subtract explicit costs, such as charges for labour, equipment, and other supplies, from the revenue he receives.

Economists recognise costs in addition to the explicit costs listed by accountants. If Tony were not growing radishes, he could be doing something else with the land and with his own efforts. Suppose the most valuable alternative use of his land would be to produce carrots, from which Tony could earn RM250 per month in accounting profits. The income he forgoes by not producing carrots is an opportunity cost of producing radishes. This cost is not explicit; the return Tony could get from producing carrots will not appear on a conventional accounting statement of his accounting profit. A cost that is included in the economic concept of opportunity cost, but that is not an explicit cost, is called an implicit cost.

The long run and zero economic profits

Given our definition of economic profits, we can easily see why, in perfect competition, they must always equal zero in the long run. Suppose there are two industries in the economy, and that firms in Industry A are earning economic profits. By definition, firms in Industry A are earning a return greater than the return available in Industry B. That means that firms in Industry B are earning less than they could in Industry A. Firms in Industry B are experiencing economic losses.

Given easy entry and exit, some firms in Industry B will leave it and enter Industry A to earn the greater profits available there. As they do so, the supply curve in Industry B will shift to the left, increasing prices and profits there. As former Industry B firms enter Industry A, the supply curve in Industry A will shift to the right, lowering profits in A. The process of firms leaving Industry B and entering A will continue until firms in both industries are earning zero economic profit. That suggests an important long-run result: Economic profits in a system of perfectly competitive markets will, in the long run, be driven to zero in all industries.

Eliminating economic profit: The role of entry

The process through which entry will eliminate economic profits in the long run is illustrated in **Figure 3.19**, which is based on the situation presented in **Figure 3.15**. The price of radishes is RM0.40 per pound. Tony's average total cost at an output of 6,700 pounds of radishes per month is RM0.26 per pound. Profit per unit is RM0.14 (RM0.40 – RM0.26). Tony thus earns a profit of RM938 per month (= RM0.14 × 6,700).

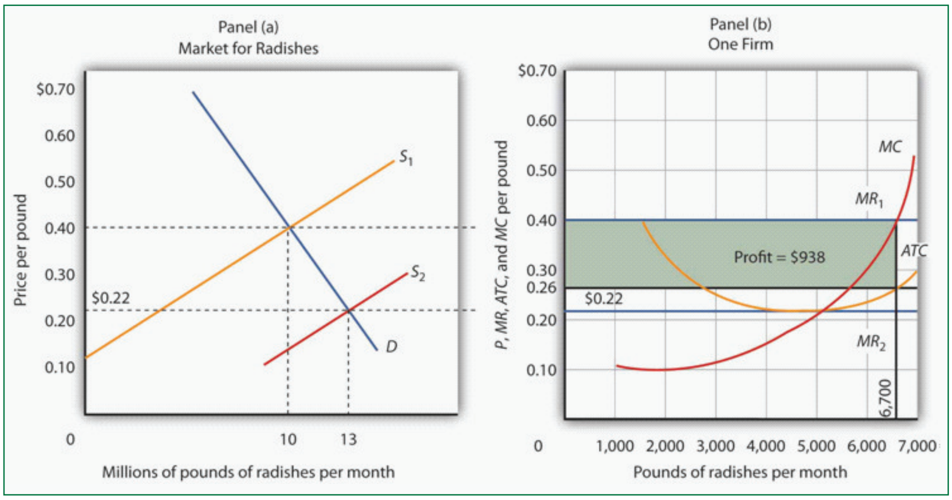


Figure 3.19 Eliminating economic profits in the long run

If firms in an industry are making an economic profit, entry will occur in the long run. In Panel (b), a single firm's profit is shown by the shaded area. Entry continues until firms in the industry are operating at the lowest point on their respective average total cost curves, and economic profits fall to zero.

Profits in the radish industry attract entry in the long run. Panel (a) of **Figure 3.19** shows that as firms enter, the supply curve shifts to the right and the price of radishes falls. New firms enter as long as there are economic profits to be made — as long as price exceeds *ATC* in Panel (b). As price falls, marginal revenue falls to MR2 and the firm reduces the quantity it supplies, moving along the marginal cost (*MC*) curve to the lowest point on the *ATC* curve, at RM0.22 per pound and an output of 5,000 pounds per month. Although the output of individual firms falls in response to falling prices, there are now more firms, so industry output rises to 13 million pounds per month in Panel (a).

Eliminating losses: The role of exit

Just as entry eliminates economic profits in the long run, exit eliminates economic losses. In **Figure 3.20**, Panel (a) shows the case of an industry in which the market price *P*1 is below *ATC*. In Panel (b), at price *P*1 a single firm produces a quantity *q*1, assuming it is at least covering its average variable cost. The firm's losses are shown by the shaded rectangle bounded by its average total cost *C*1 and price *P*1 and by output *q*1. Because firms in the industry are losing money, some will exit. The supply curve in Panel (a) shifts to the left, and it continues shifting as long as firms are suffering losses. Eventually the supply curve shifts all the way to *S*2, price rises to *P*2, and economic profits return to zero.

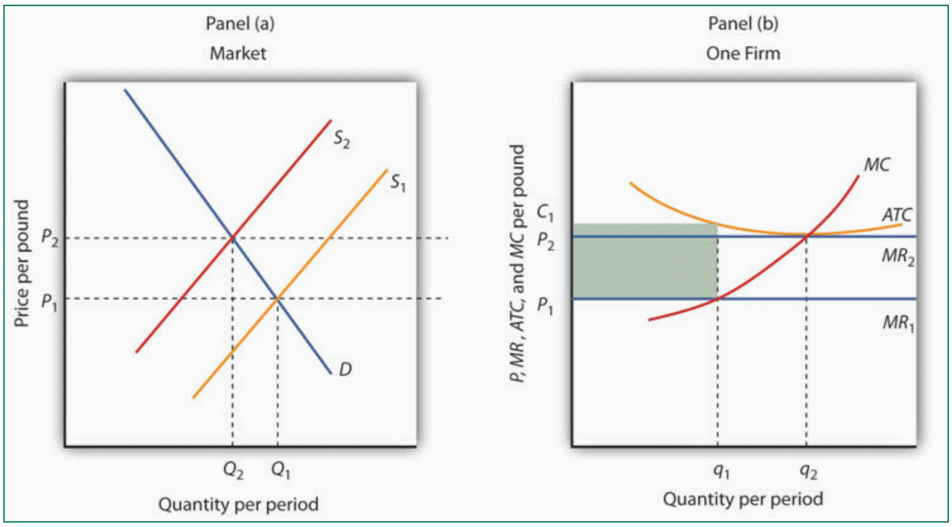


Figure 3.20 Eliminating economic losses in the long run

Panel (b) shows that at the initial price P1, firms in the industry cannot cover average total cost (MR1 is below ATC). That induces some firms to leave the industry, shifting the supply curve in Panel (a) to S2, reducing industry output to Q2 and raising price to P2. At that price (MR2), firms earn zero economic profit, and exit from the industry ceases. Panel (b) shows that the firm increases output from q1 to q2; total output in the market falls in Panel (a) because there are fewer firms. Notice that in Panel (a) quantity is designated by uppercase Q, while in Panel (b) quantity is designated by lowercase q. This convention is used throughout the text to distinguish between the quantity supplied in the market (Q) and the quantity supplied by a typical firm (q).

Entry, exit and production costs

In our examination of entry and exit in response to economic profit or loss in a perfectly competitive industry, we assumed that the *ATC* curve of a single firm does not shift as new firms enter or existing firms leave the industry. That is the case when expansion or contraction does not affect prices for the factors of production used by firms in the industry. When expansion of the industry does not affect the prices of factors of production, it is a constant-cost industry. In some cases, however, the entry of new firms may affect input prices.

As new firms enter, they add to the demand for the factors of production used by the industry. If the industry is a significant user of those factors, the increase in demand could push up the market price of factors of production for all firms in the industry. If that occurs, then entry into an industry will boost average costs at the same time as it puts downward pressure on price. Long-run equilibrium will still occur at a zero level of economic profit and with firms operating on the lowest point on the *ATC* curve, but that cost curve will be somewhat higher than before entry occurred. Suppose, for example, that an increase in demand for new houses drives prices higher and induces entry. That will increase the demand for workers in the construction industry and is likely to result in higher wages in the industry, driving up costs.

An industry in which the entry of new firms bids up the prices of factors of production and thus increases production costs is called an increasing-cost industry. As such an industry expands in the long run, its price will rise.

Some industries may experience reductions in input prices as they expand with the entry of new firms. That may occur because firms supplying the industry experience economies of scale as they increase production, thus driving input prices down. Expansion may also induce technological changes that lower input costs. That is clearly the case of the computer industry, which has enjoyed falling input costs as it has expanded. An industry in which production costs fall as firms enter in the long run is a decreasing cost industry.

Just as industries may expand with the entry of new firms, they may contract with the exit of existing firms. In a constant-cost industry, exit will not affect the input prices of remaining firms. In an increasing cost industry, exit will reduce the input prices of remaining firms. And, in a decreasing-cost industry, input prices may rise with the exit of existing firms.

The behaviour of production costs as firms in an industry expand or reduce their output has important implications for the long-run industry supply curve, a curve that relates the price of a good or service to the quantity produced after all long-run adjustments to a price change have been completed. Every point on a long-run supply curve therefore shows a price and quantity supplied at which firms in the industry are earning zero economic profit. Unlike the short-run market supply curve, the long-run industry supply curve does not hold factor costs and the number of firms unchanged.

Figure 3.21 "Long-run supply curves in perfect competition" shows three long-run industry supply curves. In Panel (a), SCC is a long-run supply curve for a constant-cost industry. It is horizontal. Neither expansion nor contraction by itself affects market price. In Panel (b), SIC is a long-run supply curve for an increasing-cost industry. It rises as the industry expands. In Panel (c), SDC is a long-run supply curve for a decreasing-cost industry. Its downward slope suggests a falling price as the industry expands.

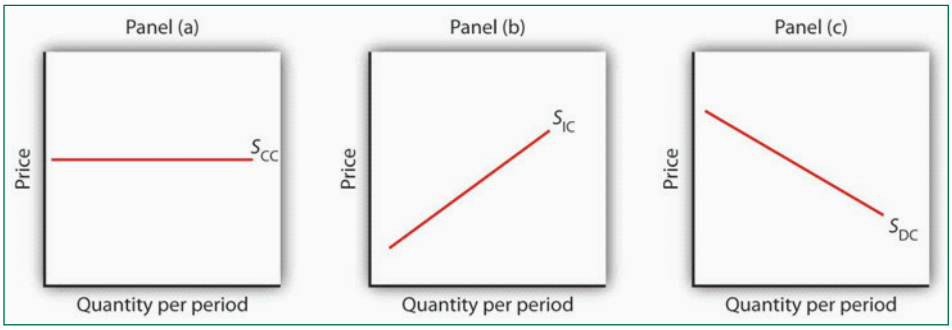


Figure 3.21 Long-run supply curves in perfect competition

The long-run supply curve for a constant-cost, perfectly competitive industry is a horizontal line, SCC, shown in Panel (a). The long-run curve for an increasing-cost industry is an upward sloping curve, SIC, as in Panel (b). The downward-sloping long-run supply curve, SDC, for a decreasing cost industry is given in Panel (c).

Changes in demand and in production cost

The primary application of the model of perfect competition is in predicting how firms will respond to changes in demand and in production costs. To see how firms respond to a particular change, we determine how the change affects demand or cost conditions and then see how the profit-maximising solution is affected in the short run and in the long run. Having determined how the profit-maximising firms of the model would respond, we can then predict firms' responses to similar changes in the real world.

In the examples that follow, we shall assume, for simplicity, that entry or exit do not affect the input prices facing firms in the industry. That is, we assume a constant-cost industry with a horizontal long-run industry supply curve similar to SCC in **Figure 3.21**. We shall assume that firms are covering their average variable costs, so we can ignore the possibility of shutting down.

Changes in demand

Changes in demand can occur for a variety of reasons. There may be a change in preferences, incomes, the price of a related good, population, or consumer expectations. A change in demand causes a change in the market price, thus shifting the marginal revenue curves of firms in the industry. Let us consider the impact of a change in demand for oats. Suppose new evidence suggests that eating oats not only helps to prevent heart disease, but also prevents baldness in males. This will, of course, increase the demand for oats. To assess the impact of this change, we assume that the industry is perfectly competitive and that it is initially in long-run equilibrium at a price of RM1.70 per bushel. Economic profits equal zero.

The initial situation is depicted in **Figure 3.22**. Panel (a) shows that at a price of RM1.70, industry output is Q1 (point A), while Panel (b) shows that the market price constitutes the marginal revenue, *MR*1, facing a single firm in the industry. The firm responds to that price by finding the output level at which the *MC* and *MR*1 curves intersect. That implies a level of output *q*1 at point A'.

The new medical evidence causes demand to increase to *D*2 in Panel (a). That increases the market price to RM2.30 (point B), so the marginal revenue curve for a single firm rises to *MR*2 in Panel (b). The firm responds by increasing its output to *q*2 in the short run (point B'). Notice that the firm's average total cost is slightly higher than its original level of RM1.70; that is because of the U shape of the curve. The firm is making an economic profit shown by the shaded rectangle in Panel (b). Other firms in the industry will earn an economic profit as well, which, in the long run, will attract entry by new firms. New entry will shift the supply curve to the right; entry will continue as long as firms are making an economic profit. The supply curve in Panel (a) shifts to *S*2, driving the price down in the long run to the original level of RM1.70 per bushel and returning economic profits to zero in long-run equilibrium. A single firm will return to its original level of output, *q*1 (point A') in Panel (b), but because there are more firms in the industry, industry output rises to *Q*3 (point C) in Panel (a).

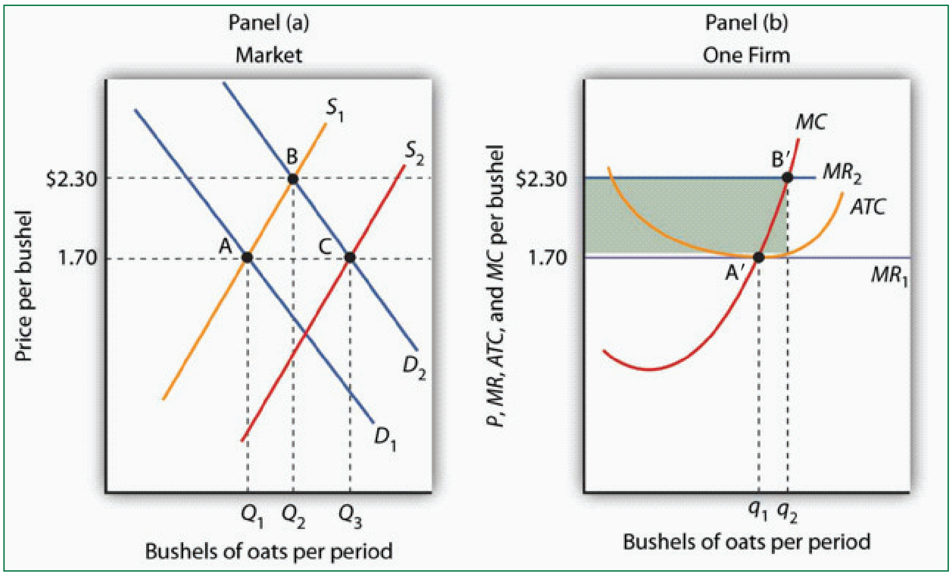


Figure 3.22 Short-run and long-run adjustments to an increase in demand

The initial equilibrium price and output are determined in the market for oats by the intersection of demand and supply at point A in Panel (a). An increase in the market demand for oats,from D1 to D2 in Panel (a), shifts the equilibrium solution to point B. The price increases in the short run from RM1.70 per bushel to RM2.30. Industry output rises to Q2. For a single firm, the increase in price raises marginal revenue from MR1to MR2; the firm responds in the short run by increasing its output to q2. It earns an economic profit given by the shaded rectangle. In the long run, the opportunity for profit attracts new firms. In a constant-cost industry, the short-run supply curve shifts to S2; market equilibrium now moves to point C in Panel (a). The market price falls back to RM1.70. The firm's demand curve returns to MR1, and its output falls back to the original level, q1. Industry output has risen to Q3 because there are more firms.

A reduction in demand would lead to a reduction in price, shifting each firm's marginal revenue curve downward. Firms would experience economic losses, thus causing exit in the long run and shifting the supply curve to the left. Eventually, the price would rise back to its original level, assuming changes in industry output did not lead to changes in input prices. There would be fewer firms in the industry, but each firm would end up producing the same output as before.

Changes in production cost

A firm's costs change if the costs of its inputs change. They also change if the firm is able to take advantage of a change in technology. Changes in production cost shift the ATC curve. If a firm's variable costs are affected, its marginal cost curves will shift as well. Any change in marginal cost produces a similar change in industry supply, since it is found by adding up marginal cost curves for individual firms. Suppose a reduction in the price of oil reduces the cost of producing oil changes for automobiles. We shall assume that the oil-change industry is perfectly competitive and that it is initially in long-run equilibrium at a price of RM27 per oil change, as shown in Panel (a) of **Figure 3.23**. Suppose that the reduction in oil prices reduces the cost of an oil change by RM3.

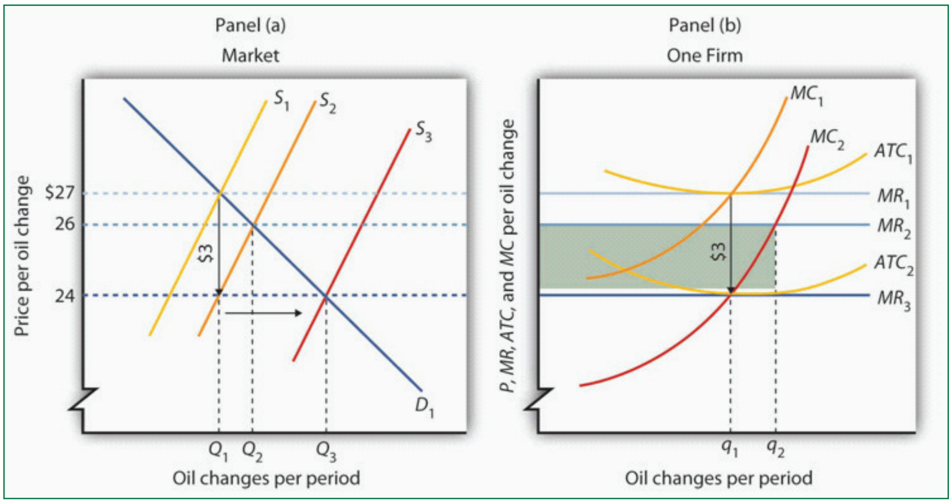


Figure 3.23 A reduction in the cost of producing oil changes

The initial equilibrium price, RM27, and quantity, Q1, of automobile oil changes are determined by the intersection of market demand, D1, and market supply, S1 in Panel (a). The industry is in long-run equilibrium; a typical firm, shown in Panel (b), earns zero economic profit. A reduction in oil prices reduces the marginal and average total costs of producing an oil change by RM3. The firm's marginal cost curve shifts to MC2, and its average total cost curve shifts to ATC2. The short-run industry supply curve shifts down by RM3 to S2. The market price falls to RM26; the firm increases its output toq2 and earns an economic profit given by the shaded rectangle. In the long run, the opportunity for profit shifts the industry supply curve to S3. The price falls to RM24, and the firm reduces its output to the original level, q1. It now earns zero economic profit once again. Industry output in Panel (a) rises to Q3 because there are more firms; price has fallen by the full amount of the reduction in production costs.

A reduction in production cost shifts the firm's cost curves down. The firm's average total cost and marginal cost curves shift down, as shown in Panel (b). In Panel (a) the supply curve shifts from *S*1 to *S*2. The industry supply curve is made up of the marginal cost curves of individual firms; because each of them has shifted downward by RM3, the industry supply curve shifts downward by RM3.

Notice that price in the short run falls to RM26; it does not fall by the RM3 reduction in cost. That is because the supply and demand curves are sloped. While the supply curve shifts downward by RM3, its intersection with the demand curve falls by less than RM3. The firm in Panel (b) responds to the lower price and lower cost by increasing output to *q*2, where *MC*2 and *MR*2 intersect. That leaves firms in the industry with an economic profit; the economic profit for the firm is shown by the shaded rectangle in Panel (b). Profits attract entry in the long run, shifting the supply curve to the right to S3 in Panel (a) Entry will continue as long as firms are making an economic profit — it will thus continue until the price falls by the full amount of the RM3 reduction in cost. The price falls to RM24, industry output rises to *Q*3, and the firm's output returns to its original level, *q*1.

An increase in variable costs would shift the average total, average variable, and marginal cost curves upward. It would shift the industry supply curve upward by the same amount. The result in the short run would be an increase in price, but by less than the increase in cost per unit. Firms would experience economic losses, causing exit in the long run. Eventually, price would increase by the full amount of the increase in production cost.

Some cost increases will not affect marginal cost. Suppose, for example, that an annual license fee of RM5,000 is imposed on firms in a particular industry. The fee is a fixed cost; it does not affect marginal cost. Imposing such a fee shifts the average total cost curve upward but causes no change in marginal cost. There is no change in price or output in the short run. Because firms are suffering economic losses, there will be exit in the long run. Prices ultimately rise by enough to cover the cost of the fee, leaving the remaining firms in the industry with zero economic profit.

Price will change to reflect whatever change we observe in production cost. A change in variable cost causes price to change in the short run. In the long run, any change in average total cost changes price by an equal amount.

The message of long-run equilibrium in a competitive market is a profound one. The ultimate beneficiaries of the innovative efforts of firms are consumers. Firms in a perfectly competitive world earn zero profit in the long-run. While firms can earn accounting profits in the long-run, they cannot earn economic profits.

Summary

The assumptions of the model of perfect competition ensure that every decision maker is a price taker — the interaction of demand and supply in the market determines price. Although most firms in real markets have some control over their prices, the model of perfect competition suggests how changes in demand or in production cost will affect price and output in a wide range of real-world cases. A firm in perfect competition maximises profit in the short run by producing an output level at which marginal revenue equals marginal cost, provided marginal revenue is at least as great as the minimum value of average variable cost. For a perfectly competitive firm, marginal revenue equals price and average revenue. This implies that the firm's marginal cost curve is its short-run supply curve for values greater than average variable cost. If price drops below average variable cost, the firm shuts down. If firms in an industry are earning economic profit, entry by new firms will drive price down until economic profit achieves its long-run equilibrium value of zero. If firms are suffering economic losses, exit by existing firms will continue until price rises to eliminate the losses and economic profits are zero. A long -run equilibrium may be changed by a change in demand or in production cost, which would affect supply. The adjustment to the change in the short run is likely to result in economic profits or losses; these will be eliminated in the long run by entry or by exit.

Self-test 3.4

1. Which of the following goods and services are likely produced in a perfectly competitive industry? Relate your answer to the assumptions of the model of perfect competition.

    a. International express mail service

    b. Corn

    c. Athletic shoes

2. Consider Acme Clothing's situation in **Self-test 3.3**. Suppose this situation is typical of firms in the jacket market. Explain what will happen in the market for jackets in the long run, assuming nothing happens to the prices of factors of production used by firms in the industry. What will happen to the equilibrium price? What is the equilibrium level of economic profits?

Summary of Unit 3

Summary

Throughout this unit we have looked at the implication of the inputs used in the production function whether in the short-run or long-run. The law of diminishing returns which controls the production in the short-run where briefly discussed. Short-run production is influenced by the ratio between fixed input and variable input. To increase production, variable inputs need to be increased hence increasing total cost.

However, in the long-run, all inputs are variable which makes increasing outputs a lot easier. Firms would need to increase variable inputs and fixed inputs to maximise production. Interestingly, the increase in production brings an improvement in efficiency. Efficiency will reduce costs. Hence, economies of scale are experienced by many firms. Unfortunately, lack of planning or coordination creates an adverse affect on production leading to the diseconomies of scale faced by many.

The last section of this unit looked at the perfectly competitive market which begins out study of market structure. Firms with homogenous products will sell products at the same price since there is perfect competition in the market. These firms usually can get profit in the short-run. However, in the long-run, these firms face zero profit due to the easy entry (and exit) existence in this market structure.

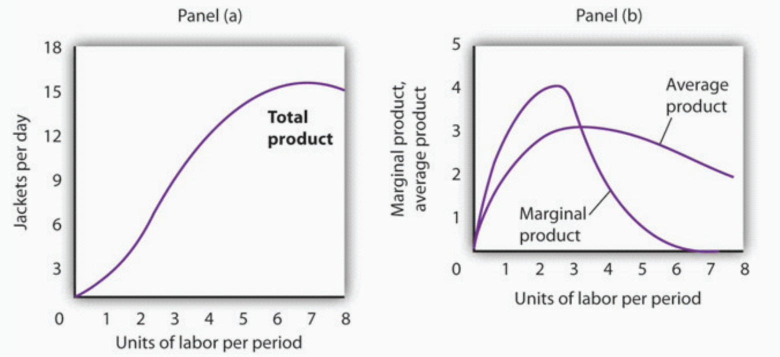
Suggested Answers to Self-tests

Feedback

Self-test 3.1

1.

Units of labor per day	0	1	2	3	4	5	6	7	8
Jackets per day	0	2	5.5	9.5	12	14	15	15.5	15
Marginal product		2	3.5	4.0	2.5	2.0	1.0	0.5	−0.5
Average product		2	2.75	3.17	3	2.8	2.5	2.21	1.88



2. a. The increased wage will shift the total variable cost curve upward; the old and new points and the corresponding curves are shown at the right.

   b. The total variable cost curve has shifted upward because the cost of labour, Acme's variable factor, has increased. The marginal cost curve shows the additional cost of each additional unit of output a firm produces. Because an increase in output requires more labour, and because labour now costs more, the marginal cost curve will shift upward. The increase in total variable cost will increase total cost; average total and average variable costs will rise as well. Average fixed cost will not change.

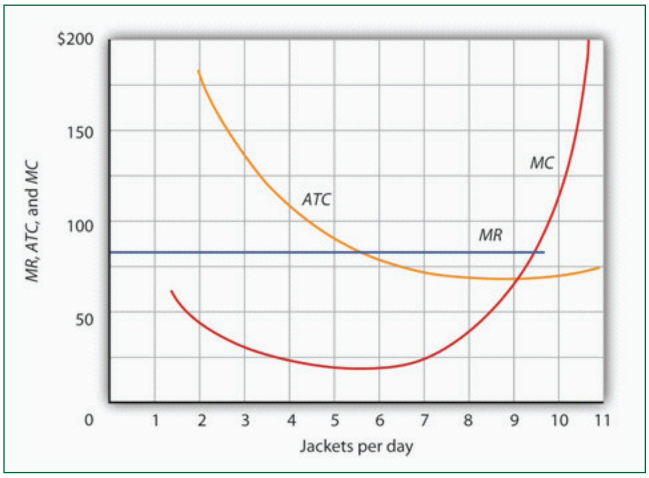
Self-test 3.2

1. To produce 9 jackets, Acme uses 4 units of labour.

2. In the long run, Acme will substitute capital for labour. It cannot make this adjustment in the short run, because its capital is fixed in the short run.

Self-test 3.3

At a price of RM81, Acme's marginal revenue curve is a horizontal line at RM81. The firm produces the output at which marginal cost equals marginal revenue; the curves intersect at a quantity of 9 jackets per day. Acme's average total cost at this level of output equals RM67, for an economic profit per jacket of RM14. Acme's economic profit per day equals RM14 × 9 = RM126.



Self-test 3.4

1. a. Not perfectly competitive — There are few sellers in this market (FedEx, UPS, DHL and Skynet are the main ones in Malaysia) probably because of the difficulty of entry and exit. To provide these services requires many outlets and a large transportation fleet, for example.

   b. Perfectly competitive — There are many firms producing a largely homogeneous product and there is good information about prices. Entry and exit is also fairly easy as firms can switch among a variety of crops.

   c. Not perfectly competitive — The main reason is that goods are not identical.

2. The availability of economic profits will attract new firms to the jacket industry in the long run, shifting the market supply curve to the right. Entry will continue until economic profits are eliminated. The price will fall; Acme's marginal revenue curve shifts down. The equilibrium level of economic profits in the long run is zero.