*Unit 5*

BBM 102/05

Microeconomics

# Factor Markets, Externalities and Public Goods

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 Designers: Deam Enterprise and 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.

© 2013 Wawasan Open University. Except where otherwise noted, this work is licensed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported license. To view a copy of this license, visit http://creativecommons.org/licenses/by-nc-sa/3.0/ or send a letter to Creative Commons, 444 Castro Street, Suite 900, Mountain View, California, 94041, USA.

This course material was published to support the learning of students registered with Wawasan Open University. Wawasan Open University does not grant any degree, certification or credits based solely on your completion of this course material.

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 5 Factor Markets, Externalities and Public Goods


Unit overview 1

Unit objectives 2

5.1 Factor markets 3

Objectives 3

Introduction 3

Demand for labour 4

Supply for labour 10

Labour market 14

Changes in demand and supply 15

Competitive labour markets and the minimum wage 17

5.2 Interest rates and capital 21

Objectives 21

Introduction 21

The demand for capital 21

The market for loanable funds 24

5.3 Natural resources and conservation 31

Objectives 31

Introduction 31

Exhaustible natural resources 32

Renewable natural resources 33

Economic rent and the market for land 34

5.4 Market failure 37

Objectives 37

Introduction 37

Non-competitive markets 37

Public goods 38

Free riders 38

Public goods and the government 39

External costs and benefits 40

External costs and efficiency 41

External costs and government intervention 42

Common property resources 42

Summary of Unit 5 45

Course summary 47

Suggested answers to self-tests 49

References 55

# Unit Overview

Unit 5 covers two important microeconomic topics. The first topic which has three sections, discusses **factor markets including labour, capital and natural resources.** The second topic covers **externalities** and **public goods**.

The unit begins with an elaboration of **the theory of labour markets** in some detail using a standard market approach. It discusses demand for labour, supply of labour, interaction of labour demand and supply, and comparative statistics. This section also discusses briefly the analysis of markets for other factors of production (capital and natural resources/land).

Please note that the terms in bold represent the important terms/concepts that you must understand in this unit. Again, make sure you test your understanding of the unit's concepts by attempting the self-tests and online quizzes associated with Unit 5.

Topic 2 of this unit deals with the theory of **externalities** while examining the theory of **public goods** and **common resources**. Sources of market failure will be introduced in this section as well.

A side effect of an action that affects the well being of a third party is known as an externality. A competitive market with externalities does not lead to efficient outcomes since "when one determines what action to take" the affecting party does not take into consideration the effects of an action on the affected party or parties. You will learn more about the theory later. Externalities create inefficiency. What should we do about them? Are there public policies that can reduce inefficiency? Are there private actions that can reduce inefficiency? You will learn about the policy options to reduce the problems created by externalities.

There is one policy option that is worth mentioning right now: to do nothing and to rely on free negotiating or contracting by the involved parties to reach an efficient outcome. Is such an option feasible? When is it feasible and when is it not? You will find the answer to this question later in this unit.

# Unit Objectives

By the end of Unit 5, you should be able to:

1. Explain labour market equilibrium and how various factors shift the equilibrium.

2. Extend the analysis of labour markets to markets for other factors of production.

3. Provide a realistic assessment of the effects of minimum wage laws.

4. Describe and explain the theory of externalities.

5. Illustrate the different public policies used to reduce the problem of externalities.

6. Explain the characteristics of public goods and examine why private markets fail to provide public goods.

# 5.1 Factor Markets

## Objectives

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

1. Describe how to find the market demand curve for labour and discuss the factors that can cause the market demand curve for labour to shift.

2. Discuss the factors that can cause the supply curve for labour to shift.

3. Explain and illustrate how wage and employment levels are determined in a perfectly competitive market and for an individual firm within that market.

4. Describe the forces that can raise or lower the equilibrium wage in a competitive market and illustrate these processes.

5. Describe the ways that government can increase wages and incomes.

## Introduction

The first part of this unit focuses on factor markets, that is, on markets in which households supply factors of production — labour, capital and natural resources — demanded by firms. Our focus in this section is on labour markets that operate in a competitive environment in which the individual buyers and sellers of labour are assumed to be price takers. Other sections on factor markets will discuss competitive markets for capital and for natural resources.

When we use the model of demand and supply to analyze the determination of wages and employment, we are assuming that market forces, not individuals, determine wages in the economy. The model says that equilibrium wages are determined by the intersection of the demand and supply curves for labour in a particular market. Workers and firms in the market are thus price takers; they take the market-determined wage as given and respond to it. We are, in this instance, assuming that perfect competition prevails in the labour market. Just as there are some situations in the analysis of markets for goods and services for which such an assumption is inappropriate, so there are some cases in which the assumption is inappropriate for labour markets. We examine such cases in a later section. In this section, however, we will find that the assumption of perfect competition can give us important insights into the forces that determine wages and employment levels for workers.

We will begin our analysis of labour markets in the next section by looking at the forces that influence the demand for labour. In the following section we will turn to supply. In the final section, we will use what we have learned to look at labour markets at work.

## Demand for labour

A firm must have labour to produce goods and services. But how much labour will the firm employ? A profit-maximising firm will base its decision to hire additional units of labour on the marginal decision rule: If the extra output that is produced by hiring one more unit of labour adds more to total revenue than it adds to total cost, the firm will increase profit by increasing its use of labour. It will continue to hire more and more labour up to the point that the extra revenue generated by the additional labour no longer exceeds the extra cost of the labour.

For example, if a computer software company could increase its annual total revenue by RM50,000 by hiring a programmer at a cost of RM49,000 per year, the marginal decision rule says that it should do so. Since the programmer will add RM49,000 to total cost and RM50,000 to total revenue, hiring the programmer will increase the company's profit by RM1,000. If still another programmer would increase annual total revenue by RM48,000 but would also add RM49,000 to the firm's total cost, that programmer should not be hired because he or she would add less to total revenue than to total cost and would reduce profit.

### Marginal revenue product and marginal factor cost

The amount that an additional unit of a factor adds to a firm's total revenue during a period is called the **marginal revenue product (MRP)** of the factor. An additional unit of a factor of production adds to a firm's revenue in a two-step process: first, it increases the firm's output. Second, the increased output increases the firm's total revenue. We find marginal revenue product by multiplying the marginal product (MP) of the factor by the marginal revenue (MR).

*Equation 5.1*

$$MRP = MP \times MR$$

In a perfectly competitive market the marginal revenue a firm receives equals the market-determined price P. Therefore, for firms in perfect competition, we can express marginal revenue product as follows:

*Equation 5.2*

In perfect competition, $MRP = MP \times P$

The marginal revenue product of labour ($MRP_L$) is the marginal product of labour (MPL) times the marginal revenue (which is the same as price under perfect competition) the firm obtains from additional units of output that result from hiring the additional unit of labour. If an additional worker adds 4 units of output per day to a firm's production, and if each of those 4 units sells for RM20, then the worker's marginal revenue product is RM80 per day. With perfect competition, the

marginal revenue product for labour, $MRP_L$, equals the marginal product of labour, $MP_L$, times the price, P, of the good or service the labour produces:

*Equation 5.3*

In perfect competition, $MRP_L = MP_L \times P$

The law of diminishing marginal returns tells us that if the quantity of a factor is increased while other inputs are held constant, its marginal product will eventually decline. If marginal product is falling, marginal revenue product must be falling as well.

Suppose that an accountant, Ms. Choong, has started an evening call-in tax advisory service. Between the hours of 7 p.m. and 10 p.m., customers can call and get advice on their income taxes. Ms. Choong's firm, TeleTax, is one of several firms offering similar advice; the going market price is RM10 per call.

Ms. Choong's business has expanded, so she hires other accountants to handle the calls. She must determine how many accountants to hire. As Ms. Choong adds accountants, her service can take more calls. The table in **Figure 5.1** "Marginal Product and Marginal Revenue Product" gives the relationship between the number of accountants available to answer calls each evening and the number of calls TeleTax handles. Panel (a) shows the increase in the number of calls handled by each additional accountant — that accountant's marginal product. The first accountant can handle 13 calls per evening. Adding a second accountant increases the number of calls handled by 20. With two accountants, a degree of specialization is possible if each accountant takes calls dealing with questions about which he or she has particular expertise. Hiring the third accountant increases TeleTax's output per evening by 23 calls. Suppose the accountants share a fixed facility for screening and routing calls. They also share a stock of reference materials to use in answering calls. As more accountants are added, the firm will begin to experience diminishing marginal returns. The fourth accountant increases output by 20 calls. The marginal product of additional accountants continues to decline after that. The marginal product curve shown in Panel (a) of **Figure 5.1** thus rises and then falls.

Each call TeleTax handles increases the firm's revenues by RM10. To obtain marginal revenue product, we multiply the marginal product of each accountant by RM10; the marginal revenue product curve is shown in Panel (b) of **Figure 5.1**.

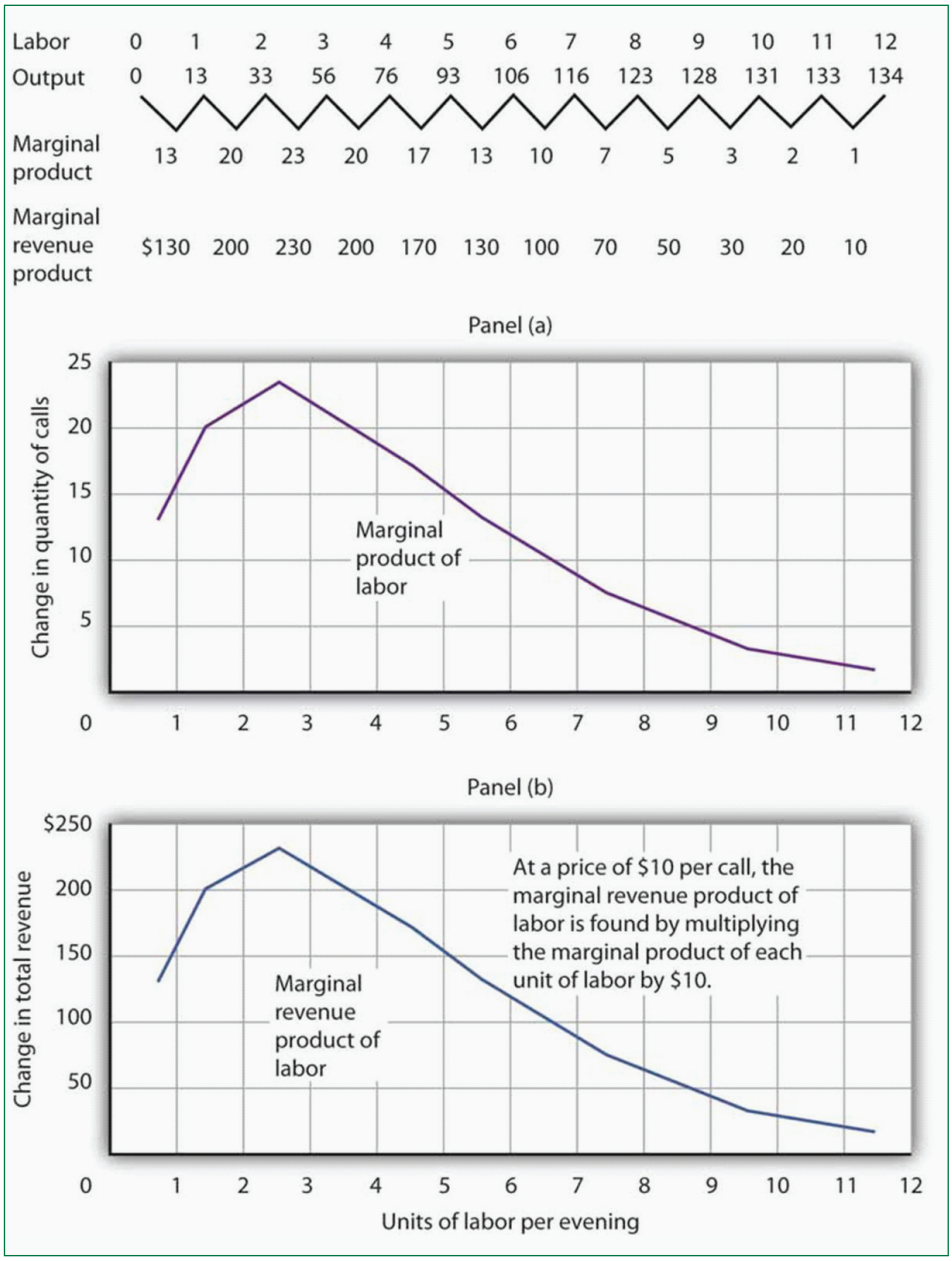



**Figure 5.1** Marginal product and marginal revenue product

*The table gives the relationship between the number of accountants employed by TeleTax each evening and the total number of calls handled. From these values we derive the marginal product and marginal revenue product curves.*

We can use Ms. Choong's marginal revenue product curve to determine the quantity of labour she will hire. Suppose accountants in her area are available to offer tax advice for a nightly fee of RM150. Each additional accountant Ms. Choong hires thus adds RM150 per night to her total cost. The amount a factor adds to a firm's total cost per period is called its **marginal factor cost (MFC)**. Marginal factor cost (MFC) is the change in total cost ($\Delta TC$) divided by the change in the quantity of the factor ($\Delta f$).

*Equation 5.4*

$$MFC = \frac{\Delta TC}{\Delta f}$$

The marginal factor cost to TeleTax of additional accountants (RM150 per night) is shown as a horizontal line in **Figure 5.2** "Marginal Revenue Product and Demand". It is simply the market wage (i.e., the price per unit of labour).

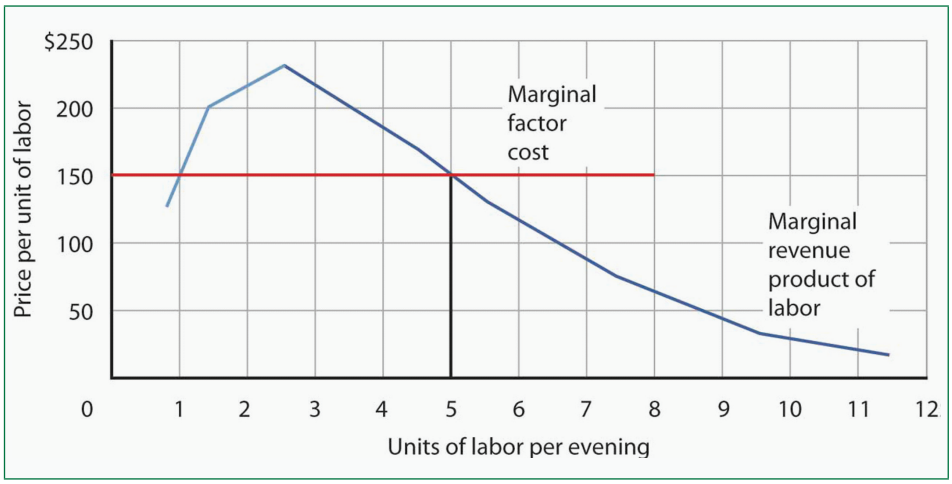



**Figure 5.2** Marginal revenue product and demand

*The downward-sloping portion of a firm's marginal revenue product curve is its demand curve for a variable factor. At a marginal factor cost of RM150, TeleTax hires the services of five accountants.*

TeleTax will maximise profit by hiring additional units of labour up to the point where the downward-sloping portion of the marginal revenue product curve intersects the marginal factor cost curve; we see in **Figure 5.2** that it will hire five accountants. Based on the information given in the table in **Figure 5.1**, we know that the five accountants will handle a total of 93 calls per evening; TeleTax will earn total revenue of RM930 per evening. The firm pays RM750 for the services of the five accountants — that leaves RM180 to apply to the fixed cost associated with the tax advice service and the implicit cost of Ms Choong's effort in organising the service. Recall that these implicit costs include the income forgone (that is, opportunity cost) by not shifting her resources, including her own labour, to her next best alternative.

If TeleTax had to pay a higher price for accountants, it would face a higher marginal factor cost curve and would hire fewer accountants. If the price were lower, TeleTax would hire more accountants. The downward-sloping portion of TeleTax's marginal revenue product curve shows the number of accountants it will hire at each price for accountants; it is thus the firm's demand curve for accountants. It is the portion of the curve that exhibits diminishing returns, and a firm will always seek to operate in the range of diminishing returns to the factors it uses.

It may seem counterintuitive that firms do not operate in the range of increasing returns, which would correspond to the upward-sloping portion of the marginal revenue product curve. However, to do so would forgo profit-enhancing opportunities. For example, in **Figure 5.2**, adding the second accountant adds RM200 to revenue but only RM150 to cost, so hiring that accountant clearly adds to profit. But why stop there? What about hiring a third accountant? That additional hire adds even more to revenue (RM230) than to cost. In the region of increasing returns, marginal revenue product rises. With marginal factor cost constant, not to continue onto the downward-sloping part of the marginal revenue curve would be to miss out on profit-enhancing opportunities. The firm continues adding accountants until doing so no longer adds more to revenue than to cost, and that necessarily occurs where the marginal revenue product curve slopes downward. In general, then, we can interpret the downward-sloping portion of a firm's marginal revenue product curve for a factor as its demand curve for that factor. We find the market demand for labour by adding the demand curves for individual firms.

## Shifts in labour demand

The fact that a firm's demand curve for labour is given by the downward-sloping portion of its marginal revenue product of labour curve provides a guide to the factors that will shift the curve. In perfect competition, marginal revenue product equals the marginal product of labour times the price of the good (refer to Equation 5.3) that the labour is involved in producing; anything that changes either of those two variables will shift the curve. The marginal revenue product of labour will change when there is a change in the quantities of other factors employed. It will also change as a result of a change in technology, a change in the price of the good being produced, or a change in the number of firms hiring the labour.

### *Changes in the use of other factors of production*

As a firm changes the quantities of different factors of production it uses, the marginal product of labour may change. Having more reference manuals, for example, is likely to make additional accountants more productive — it will increase their marginal product. That increase in their marginal product would increase the demand for accountants. When an increase in the use of one factor of production increases the demand for another, the two factors are **complementary factors of production.**

One important complement of labour is human capital, the set of skills and abilities workers bring to the production of goods and services. When workers gain additional human capital their marginal product rises. The demand for them by firms thus increases. This is perhaps one reason why you have decided to pursue a college education.

Other inputs may be regarded as substitutes for each other. A robot, for example, may substitute for some kinds of assembly — line labour. Two inputs are considered **substitute factors of production** if the increased use of one lowers the demand for the other.

### *Changes in technology*

Technological changes can increase the demand for some workers and reduce the demand for others. The production of a more powerful computer chip, for example, may increase the demand for software engineers. It may also allow other production processes to be computerised and thus reduce the demand for workers who had been employed in those processes.

Technological changes have significantly increased the economy's output over the past century. The application of sophisticated technologies to production processes has boosted the marginal products of workers who have the skills these technologies require. That has increased the demand for skilled workers. The same technologies have been a substitute for less-skilled workers, and the demand for those workers has fallen. The impact of computer technology implies, envisioning the impact of technological change on demand for different kinds of labour may be something to keep in mind as you consider educational options. As you consider your major, for example, you should keep in mind that some occupations may benefit from technological changes; others may not.

### *Changes in product demand*

A change in demand for a final product changes its price, at least in the short run. An increase in the demand for a product increases its price and increases the demand for factors that produce the product. A reduction in demand for a product reduces its price and reduces the demand for the factors used in producing it. Because the demand for factors that produce a product depends on the demand for the product itself, factor demand is said to be **derived demand**. That is, factor demand is derived from the demand for the product that uses the factor in its production.

Suppose, for example, that the demand for airplanes increases. The price and quantity of airplanes available will go up. A higher price for airplanes increases the marginal revenue product of labour of airplane-assembly workers and thus increases the demand for these workers.

Just as increases in the demand for particular goods or services increase the demand for the workers that produce them, so reductions in demand for particular goods or services will reduce the demand for the workers that produce them. An example is the relationship between the demand for train travel and the demand for conductors. Over the years, the fall in demand for train travel has reduced the demand for railroad conductors.

*Changes in the number of firms*

We can determine the demand curve for any factor by adding the demand for that factor by each of the firms using it. If more firms employ the factor, the demand curve shifts to the right. A reduction in the number of firms shifts the demand curve to the left. For example, if the number of restaurants in an area increases, the demand for waiters and waitresses in the area goes up. We expect to see local wages for these workers rise as a result.

**Self-test 5.1**

How would each of the following affect the demand for labour by the accounting advice service, TeleTax, described in this section?

1. A reduction in the market price for a tax advice call

2. An increase in the market fee for the accountants that TeleTax hires

3. An increase in the marginal product of each accountant due to an expansion of the facility for screening and routing calls and an increase in the number of reference materials available to the accountants

## Supply for labour

The demand for labour is one determinant of the equilibrium wage and equilibrium quantity of labour in a perfectly competitive market. The supply of labour, of course, is the other.

Economists think of the supply of labour as a problem in which individuals weigh the opportunity cost of various activities that can fill an available amount of time and choose how to allocate it. Everyone has 24 hours in a day. There are lots of uses to which we can put our time: we can raise children, work, sleep, play, or participate in volunteer efforts. To simplify our analysis, let us assume that there are two ways in which an individual can spend his or her time: in work or in leisure. Leisure is a type of consumption good; individuals gain utility directly from it. Work provides income that, in turn, can be used to purchase goods and services that generate utility.

The more work a person does, the greater his or her income, but the smaller the amount of leisure time available. An individual who chooses more leisure time will earn less income than would otherwise be possible. There is thus a trade-off between leisure and the income that can be earned from work. We can think of the supply of labour as the flip side of the demand for leisure. The more leisure people demand, the less labour they supply.

## Wage changes and the slope of the supply curve

What would any one individual's supply curve for labour look like? One possibility is that over some range of labour hours supplied, the substitution effect will dominate. Because the marginal utility of leisure is relatively low when little labour is supplied (that is, when most time is devoted to leisure), it takes only a small increase in wages to induce the individual to substitute more labour for less leisure. Further, because few hours are worked, the income effect of those wage changes will be small.

**Figure 5.3** shows Ms. Wilson's supply curve for labour. At a wage of RM10 per hour, she supplies 42 hours of work per week (point A). An increase in her wage to RM15 per hour boosts her quantity supplied to 48 hours per week (point B). The substitution effect thus dominates the income effect of a higher wage.

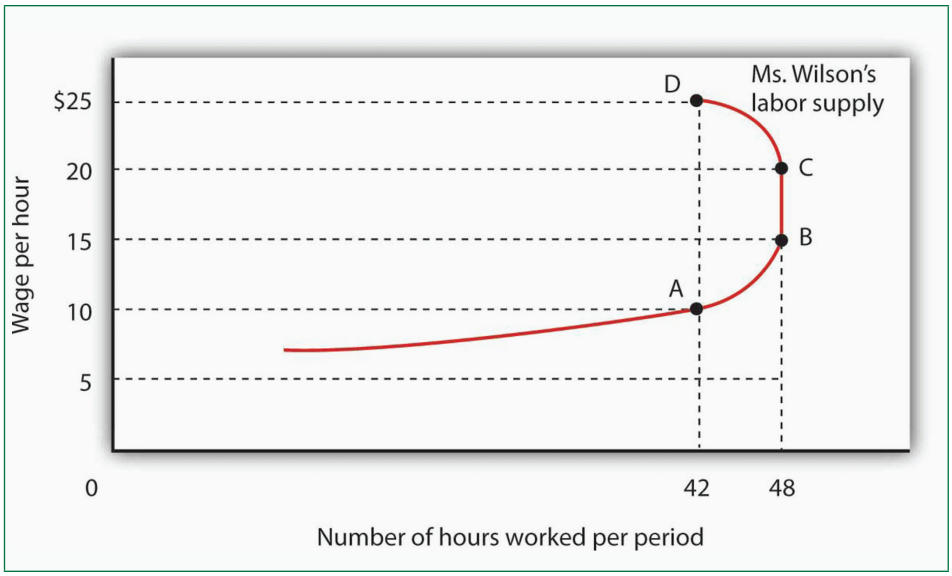



**Figure 5.3** A backward-bending supply curve for labour

*As the wage rate increases from RM10 to RM15 per hour, the quantity of labour Ms. Wilson supplies increases from 42 to 48 hours per week. Between points A and B, the positive substitution effect of the wage increase outweighs the negative income effect. As the wage rises above RM15, the negative income effect just offsets the substitution effect, and Ms. Wilson's supply curve becomes a vertical line between points B and C. As the wage rises above RM20, the income effect becomes stronger than the substitution effect, and the supply curve bends backward between points C and D.*

It is possible that beyond some wage rate, the negative income effect of a wage increase could just offset the positive substitution effect; over that range, a higher wage would have no effect on the quantity of labour supplied. That possibility is illustrated between points B and C on the supply curve in **Figure 5.3**; Ms. Wilson's supply curve is vertical. As wages continue to rise, the income effect becomes even stronger, and additional increases in the wage reduce the quantity of labour she supplies. The supply curve illustrated here bends backward beyond point C and thus assumes a negative slope. The supply curve for labour can thus slope upward over

part of its range, become vertical, and then bend backward as the income effect of higher wages begins to dominate the substitution effect.

It is quite likely that some individuals have backward-bending supply curves for labour — beyond some point, a higher wage induces those individuals to work less, not more. For example, labours who have earned high salaries would start to value their leisure time more. This would reduce time spent working at high wages. However, supply curves for labour in specific labour markets are generally upward sloping. As wages in one industry rise relative to wages in other industries, workers shift their labour to the relatively high-wage one. An increased quantity of labour is supplied in that industry. While some exceptions have been found, the mobility of labour between competitive labour markets is likely to prevent the total number of hours worked from falling as the wage rate increases. Thus we shall assume that supply curves for labour in particular markets are upward sloping.

## Shifts in labour supply

What events shift the supply curve for labour? People supply labour in order to increase their utility — just as they demand goods and services in order to increase their utility. The supply curve for labour will shift in response to changes in the same set of factors that shift demand curves for goods and services.

### *Changes in preferences*

A change in attitudes toward work and leisure can shift the supply curve for labour. If people decide they value leisure more highly, they will work fewer hours at each wage, and the supply curve for labour will shift to the left. If they decide they want more goods and services, the supply curve is likely to shift to the right.

### *Changes in income*

An increase in income will increase the demand for leisure, reducing the supply of labour. We must be careful here to distinguish movements along the supply curve from shifts of the supply curve itself. An income change resulting from a change in wages is shown by a movement along the curve; it produces the income and substitution effects we already discussed. But suppose income is from some other source: a person marries and has access to a spouse's income, or receives an inheritance, or wins a lottery. Those non-labour increases in income are likely to reduce the supply of labour, thereby shifting the supply curve for labour of the recipients to the left.

### *Changes in the prices of related goods and services*

Several goods and services are complements of labour. If the cost of child care (a complement to work effort) falls, for example, it becomes cheaper for workers to go to work, and the supply of labour tends to increase. If recreational activities (which are a substitute for work effort) become much cheaper, individuals might choose to consume more leisure time and supply less labour.

### *Changes in population*

An increase in population increases the supply of labour; a reduction lowers it. Labour organisations have generally opposed increases in immigration because their leaders fear that the increased number of workers will shift the supply curve for labour to the right and put downward pressure on wages.

### *Changes in expectations*

One change in expectations that could have an effect on labour supply is life expectancy. Another is confidence in the availability of the Employee Provident Fund (EPF) or the pension fund for civil servants. Suppose, for example, that people expect to live longer yet become less optimistic about their likely benefits from EPF. That could induce an increase in labour supply.

**Self-test 5.2**

Economists Laura Duberstein and Karen Oppenheim Mason analysed the labour-supply decisions of 1,383 mothers with preschool-aged children in the Detroit Metropolitan area. They found that respondents were more likely to work the higher the wage, less likely to work if they preferred a traditional family structure with a husband as the primary breadwinner, less likely to work if they felt that care provided by others was strongly inferior to a mother's care, and less likely to work if child care costs were higher. Given these findings, explain how each of the following would affect the labour supply of mothers with preschool-aged children.

1. An increase in the wage
2. An increase in the preference for a traditional family structure
3. An increased sense that child care is inferior to a mother's care
4. An increase in the cost of child care

(Remember to distinguish between movements along the curve and shifts of the curve.)

Is the labour supply curve positively or negatively sloped? Does the substitution effect or income effect dominate?

## Labour markets

We have seen that a firm's demand for labour depends on the marginal product of labour and the price of the good the firm produces. We add the demand curves of individual firms to obtain the market demand curve for labour. The supply curve for labour depends on variables such as population and worker preferences. Supply in a particular market depends on variables such as worker preferences, the skills and training a job requires, and wages available in alternative occupations. Wages are determined by the intersection of demand and supply.

Once the wage in a particular market has been established, individual firms in perfect competition take it as given. Because each firm is a price taker, it faces a horizontal supply curve for labour at the market wage. For one firm, changing the quantity of labour it hires does not change the wage. In the context of the model of perfect competition, buyers and sellers are price takers. That means that a firm's choices in hiring labour do not affect the wage.

The operation of labour markets in perfect competition is illustrated in **Figure 5.4**. The wage $W1$ is determined by the intersection of demand and supply in Panel (a). Employment equals $L1$ units of labour per period. An individual firm takes that wage as given; it is the supply curve $s1$ facing the firm. This wage also equals the firm's marginal factor cost. The firm hires $l1$ units of labour, a quantity determined by the intersection of its marginal revenue product curve for labour $MRP1$ and the supply curve $s1$. We use lowercase letters to show quantity for a single firm and uppercase letters to show quantity in the market.

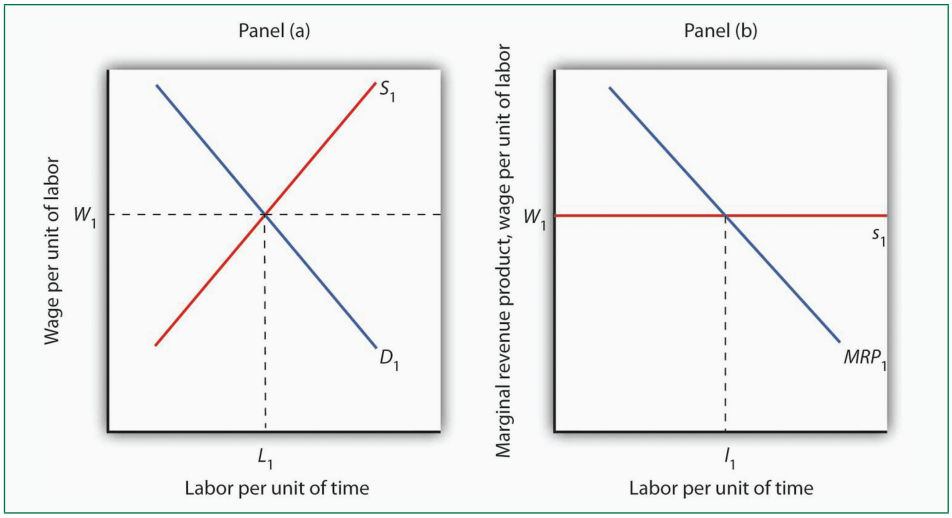



**Figure 5.4** Wage determination and employment in perfect competition

*Wages in perfect competition are determined by the intersection of demand and supply in Panel (a). An individual firm takes the wage W1 as given. It faces a horizontal supply curve for labour at the market wage, as shown in Panel (b). This supply curve s1 is also the marginal factor cost curve for labour. The firm responds to the wage by employing l1 units of labour, a quantity determined by the intersection of its marginal revenue product curve MRP1 and its supply curves1.*

## Changes in demand and supply

If wages are determined by demand and supply, then changes in demand and supply should affect wages. An increase in demand or a reduction in supply will raise wages; an increase in supply or a reduction in demand will lower them.

Panel (a) of **Figure 5.5** shows how an increase in the demand for labour affects wages and employment. The shift in demand to *D*2 pushes the wage to *W*2 and boosts employment to *L*2. Such an increase implies that the marginal product of labour has increased, that the number of firms has risen, or that the price of the good the labour produces has gone up. As we have seen, the marginal product of labour could rise because of an increase in the use of other factors of production, an improvement in technology, or an increase in human capital.

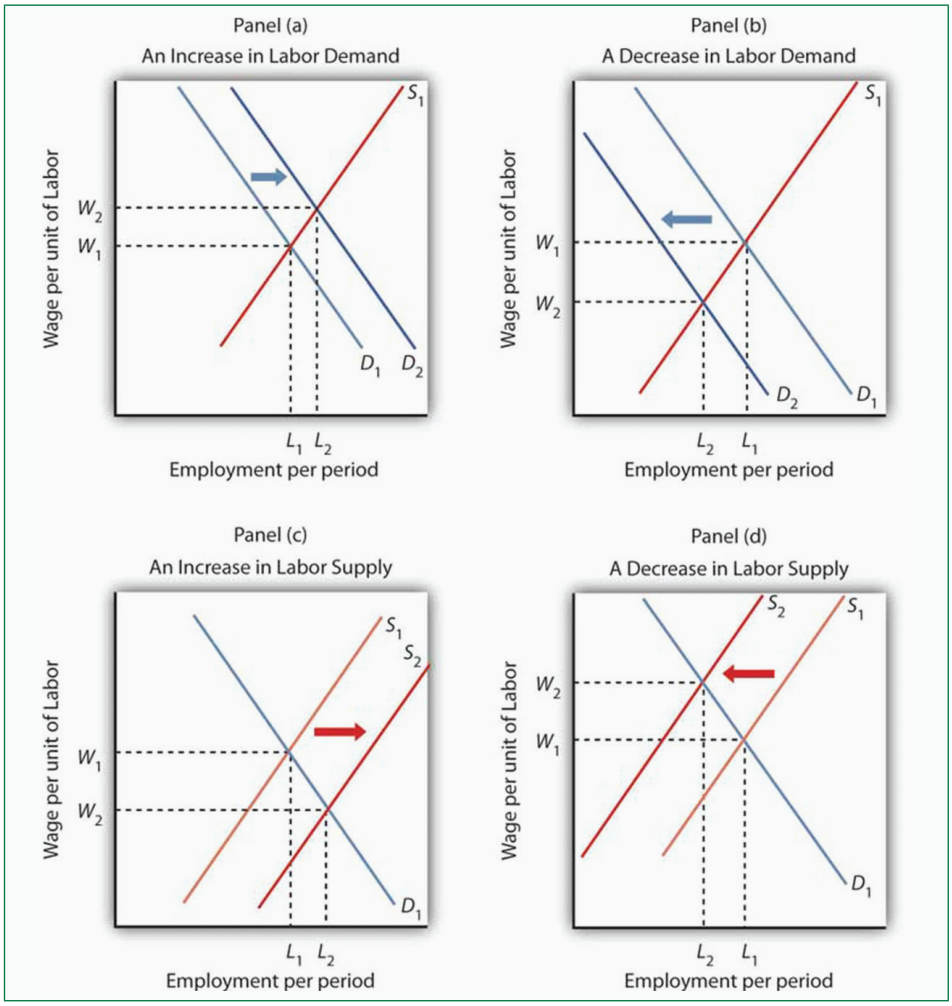



**Figure 5.5** Changes in the demand for and supply of labour

*Panel (a) shows an increase in demand for labour; the wage rises to W2 and employment rises to L2. A reduction in labour demand, shown in Panel (b), reduces employment and the wage level. An increase in the supply of labour, shown in Panel (c), reduces the wage to W2 and increases employment to L2. Panel (d) shows the effect of a reduction in the supply of labour; wages rise and employment falls.*

Clearly, a rising demand for labour has been the dominant trend in the market for U.S. labour through most of the nation's history. Wages and employment have generally risen as the availability of capital and other factors of production have increased, as technology has advanced, and as human capital has increased. All have increased the productivity of labour, and all have acted to increase wages.

Panel (b) of **Figure 5.5** shows a reduction in the demand for labour to *D*2. Wages and employment both fall. Given that the demand for labour in the aggregate is generally increasing, reduced labour demand is most often found in specific labour markets. For example, a slump in construction activity in a particular community can lower the demand for construction workers. Technological changes can reduce as well as increase demand. Technological changes since the late 1970s have tended to reduce the demand for workers with only a secondary school education while increasing the demand for those with degrees.

Panel (c) of **Figure 5.5** shows the impact of an increase in the supply of labour. The supply curve shifts to *S*2, pushing employment to *L*2 and cutting the wage to *W*2. For labour markets as a whole, such a supply increase could occur because of an increase in population or an increase in the amount of work people are willing to do. For individual labour markets, supply will increase as people move into a particular market. Just as the demand for labour has increased throughout much of the history of Malaysia, so has the supply of labour. Population has risen both through immigration and through natural increases. Such increases tend, all other determinants of wages unchanged, to reduce wages. The fact that wages have tended to rise suggests that demand has, in general, increased more rapidly than supply. Still, the more supply rises, the smaller the increase in wages will be, even if demand is rising.

Finally, Panel (d) of **Figure 5.5** shows the impact of a reduction in labour supply. One dramatic example of a drop in the labour supply was caused by a reduction in population after the outbreak of bubonic plague in Europe in 1348 — the so — called Black Death. The plague killed about one-third of the people of Europe within a few years, shifting the supply curve for labour sharply to the left. Wages doubled during the period. We are fortunate that something morbid such as this has not occurred in Malaysia.

The fact that a reduction in the supply of labour tends to increase wages explains efforts by some employee groups to reduce labour supply. Members of certain professions have successfully promoted strict licensing requirements to limit the number of people who can enter the profession — doctors, pharmacists, lawyers and company secretaries have been particularly successful in this effort. Unions often seek restrictions in immigration in an effort to reduce the supply of labour and thereby boost wages.

## Competitive labour markets and the minimum wage

Changes in technology boost the demand for highly educated workers. In turn, the resulting wage premium for more highly educated workers is a signal that encourages people to acquire more education. The market is an extremely powerful mechanism for moving resources to the areas of highest demand. At the same time, however, changes in technology seem to be leaving less educated workers behind. What will happen to people who lack the opportunity to develop the skills that the market values highly or who are unable to do so?

In order to raise wages of workers whose wages are relatively low, governments around the world have imposed minimum wages. A minimum wage works like other price floors. The impact of a minimum wage is shown in Panel (a) of **Figure 5.6**. Suppose the current equilibrium wage of unskilled workers is W1, determined by the intersection of the demand and supply curves of these workers. The government determines that this wage is too low and orders that it be increased to Wm, a minimum wage. This strategy reduces employment from *L*1 to *L*2, but it raises the incomes of those who continue to work. The higher wage also increases the quantity of labour supplied to *L*3. The gap between the quantity of labour supplied and the quantity demanded, *L*3 – *L*2, is a surplus — a surplus that increases unemployment.

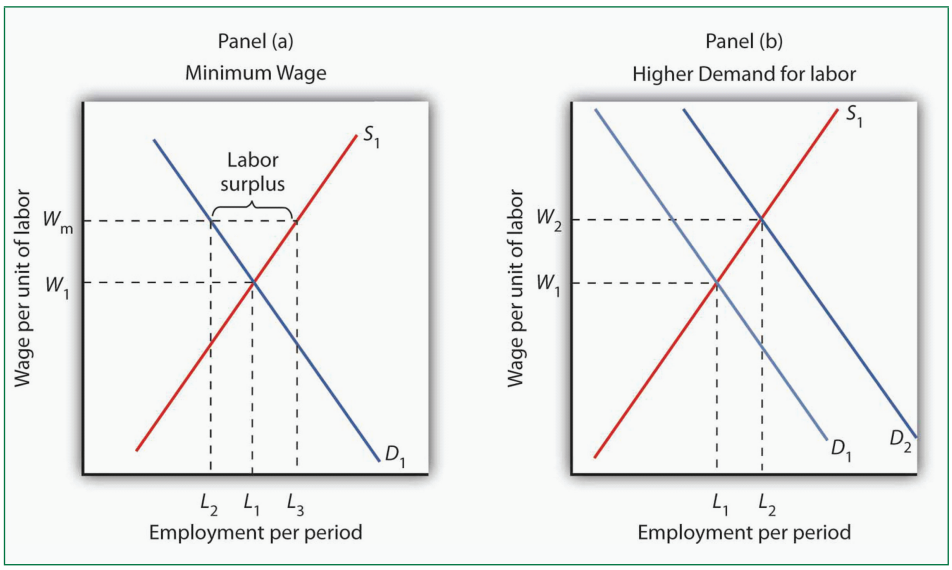



**Figure 5.6** Alternative responses to low wages

*Government can respond to a low wage by imposing a minimum wage of Wm in Panel (a). This increases the quantity of labour supplied and reduces the quantity demanded. It does, however, increase the income of those who keep their jobs. Another way the government can boost wages is by raising the demand for labour in Panel (b). Both wages and employment rise.*

Some economists oppose increases in the minimum wage on grounds that such increases boost unemployment. Other economists argue that the demand for unskilled labour is relatively inelastic, so a higher minimum wage boosts the incomes of unskilled workers as a group. That gain, they say, justifies the policy, even if it increases unemployment.

An alternative approach to imposing a legal minimum is to try to boost the demand for labour. Such an approach is illustrated in Panel (b). An increase in demand to $D2$ pushes the wage to $W2$ and at the same time increases employment to $L2$. Public sector training programs that seek to increase human capital are examples of this policy.

Still another alternative is to subsidise the wages of workers whose incomes fall below a certain level. Providing government subsidies — either to employers who agree to hire unskilled workers or to workers themselves in the form of transfer payments — enables people who lack the skills — and the ability to acquire the skills — needed to earn a higher wage to earn more without the loss of jobs implied by a higher minimum wage. Such programmes can be costly. They also reduce the incentive for low-skilled workers to develop the skills that are in greater demand in the marketplace.

## Summary

In using the model of demand and supply to examine labour markets, we assume in this unit that perfect competition exists — that all workers and employers are price takers. A firm's demand curve for a factor is the downward-sloping portion of the marginal revenue product curve of the factor. The market demand for labour is found by adding the demand curves for labour of individual firms. The market demand for labour will change as a result of a change in the use of a complementary input or a substitute input, a change in technology, a change in the price of the good produced by labour, or a change in the number of firms that employ the labour. Wages in a competitive market are determined by demand and supply. An increase in demand or a reduction in supply will increase the equilibrium wage. A reduction in demand or an increase in supply will reduce the equilibrium wage. The government may respond to low wages for some workers by imposing the minimum wage, by attempting to increase the demand for those workers, or by subsidising the wages of workers whose incomes fall below a certain level.

## Self-test 5.3

Assuming that the market for construction workers is perfectly competitive, illustrate graphically how each of the following would affect the demand or supply for construction workers. What would be the impact on wages and on the number of construction workers employed?

1. The demand for new housing increases as more people move into the community.

2. Changes in societal attitudes lead to more women wanting to work in construction.

3. Improved training makes construction workers more productive.

4. New technology allows much of the framing used in housing construction to be built by robots at a factory and then shipped to construction sites.

# 5.2 Interest Rates and Capital

## Objectives

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

1. Explain the demand curve for capital and the factors that can cause it to shift.

2. Explain and illustrate the loanable funds market and explain how changes in the demand for capital affect that market and vice versa.

## Introduction

The quantity of capital that firms employ in their production of goods and services has enormously important implications for economic activity and for the standard of living people in the economy enjoy. Increases in capital increase the marginal product of labour and boost wages at the same time they boost total output. An increase in the stock of capital therefore tends to raise incomes and improve the standard of living in the economy.

Capital is often a fixed factor of production in the short run. A firm cannot quickly retool an assembly line or add a new office building. Determining the quantity of capital a firm will use is likely to involve long-run choices.

## The demand for capital

A firm uses additional units of a factor until marginal revenue product equals marginal factor cost. Capital is no different from other factors of production, save for the fact that the revenues and costs it generates are distributed over time. As the first step in assessing a firm's demand for capital, we should determine the present value of marginal revenue products and marginal factor costs. Marginal factor costs have been covered in the previous sections. As for the concept of present value, this will be covered in BBM 202/05 Macroeconomics. As long as this unit is concerned, it is not relevant for the comprehension of students.

Because firms' choices to acquire new capital and to hold existing capital depend on the interest rate, the demand curve for capital in **Figure 5.7**, which shows the quantity of capital firms intend to hold at each interest rate, is downward-sloping. At point A, we see that at an interest rate of 10%, RM8 trillion worth of capital is demanded in the economy. At point B, a reduction in the interest rate to 7% increases the quantity of capital demanded to RM9 trillion. At point C, at an interest rate of 4%, the quantity of capital demanded is RM10 trillion. A reduction in the interest rate increases the quantity of capital demanded.

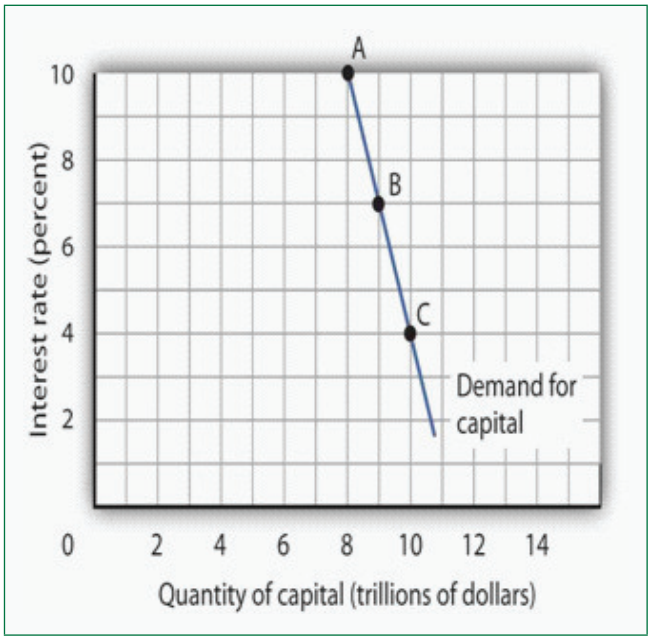



**Figure 5.7** The demand curve for capital

The quantity of capital firms will want to hold depends on the interest rate. The higher the interest rate, the less capital firms will want to hold. The demand curve for capital for the economy is found by summing the demand curves of all holders of capital. As with the demand for capital in the economy, we can expect individual firms to demand a smaller quantity of capital when the interest rate is higher.

## Shifts in the demand for capital

Why might the demand for capital change? Because the demand for capital reflects the marginal revenue product of capital, anything that changes the marginal revenue product of capital will shift the demand for capital. Our search for demand shifters must thus focus on factors that change the marginal product of capital, the prices of the goods capital produces, and the costs of acquiring and holding capital. Let us discuss some factors that could affect these variables and thus shift the demand for capital.

### *Changes in expectations*

Choices concerning capital are always based on expectations. Net present value is computed from the expected revenues and costs over the expected life of an asset. If firms' expectations change, their demand for capital will change. If something causes firms to revise their sales expectations upward (such as stronger than expected sales in the recent past), it is likely to increase their demand for capital. Similarly, an event that dampens firms' expectations (such as recent weak sales) is likely to reduce their demand for capital.

### *Technological change*

Technological changes can increase the marginal product of capital and thus boost the demand for capital. The discovery of new ways to integrate computers into production processes, for example, has dramatically increased the demand for capital in the last few years. Many universities are adding new classroom buildings or renovating old ones so they can better use computers in instruction, and businesses use computers in nearly every facet of operations.

### *Changing demand for goods and services*

Ultimately, the source of demand for factors of production is the demand for the goods and services produced by those factors. Economists say that the demand for a factor is a "derived" demand — derived, that is, from the demand for what the factor produces. As population and incomes expand, we can expect greater demand for goods and services, a change that will increase the demand for capital.

### *Changes in relative factor prices*

Firms achieve the greatest possible output for a given total cost by operating where the ratios of marginal product to factor price are equal for all factors of production. For a firm that uses labour (L) and capital (K), for example, this requires that $MP_L/P_L = MP_K/P_K$, where $MP_L$ and $MP_K$ are the marginal products of labour and capital, respectively, and PL and PK are the prices of labour and capital, respectively. Suppose these equalities hold and the price of labour rises. The ratio of the marginal product of labour to its price goes down, and the firm substitutes capital for labour. Similarly, an increase in the price of capital, all other things unchanged, would cause firms to substitute other factors of production, such as labour, for capital. The demand for capital, therefore, would fall.

### *Changes in tax policy*

Government can indirectly affect the price of capital through changes in tax policy. For example, suppose the government enacts an investment tax credit for businesses, that is, a deduction of a certain percentage of their spending on capital from their profits before paying taxes. Such a policy would effectively lower the price of capital, causing firms to substitute capital for other factors of production and increasing the demand for capital. The repeal of an investment tax credit would lead to a decrease in the demand for capital.

## The market for loanable funds

When a firm decides to expand its capital stock, it can finance its purchase of capital in several ways. It might already have the funds on hand. It can also raise funds by selling shares of stock, as we discussed in a previous chapter. When a firm sells stock, it is selling shares of ownership of the firm. It can borrow the funds for the capital from a bank. Another option is to issue and sell its own bonds. A bond is a promise to pay back a certain amount at a certain time. When a firm borrows from a bank or sells bonds, of course, it accepts a liability — it must make interest payments to the bank or the owners of its bonds as they come due.

Regardless of the method of financing chosen, a critical factor in the firm's decision on whether to acquire and hold capital and on how to finance the capital is the interest rate. The role of the interest rate is obvious when the firm issues its own bonds or borrows from a bank. But even when the firm uses its own funds to purchase the capital, it is forgoing the option of lending those funds directly to other firms by buying their bonds or indirectly by putting the funds in bank accounts, thereby allowing the banks to lend the funds. The interest rate gives the opportunity cost of using funds to acquire capital rather than putting the funds to the best alternative use available to the firm.

The interest rate is determined in a market in the same way that the price of potatoes is determined in a market: by the forces of demand and supply. The market in which borrowers (demanders of funds) and lenders (suppliers of funds) meet is the loanable funds market.

We will simplify our model of the role that the interest rate plays in the demand for capital by ignoring differences in actual interest rates that specific consumers and firms face in the economy. For example, the interest rate on credit cards is higher than the mortgage rate of interest, and large, established companies can borrow funds or issue bonds at lower interest rates than new, start-up companies can. Interest rates that firms face depend on a variety of factors, such as riskiness of the loan, the duration of the loan, and the costs of administering the loan. However, since we will focus on general tendencies that cause interest rates to rise or fall and since the various interest rates in the economy tend to move up and down together, the conclusions we reach about the market for loanable funds and how firms and consumers respond to interest rate changes will still be valid.

### The demand for loanable funds

In the previous section we learnt that a firm's decision to acquire and keep capital depends on the net present value of the capital in question, which in turn depends on the interest rate. The lower the interest rate, the greater the amount of capital that firms will want to acquire and hold, since lower interest rates translate into more capital with positive net present values. The desire for more capital means, in turn, a desire for more loanable funds. Similarly, at higher interest rates, less capital will be demanded, because more of the capital in question will have negative net present values. Higher interest rates therefore mean less funding demanded.

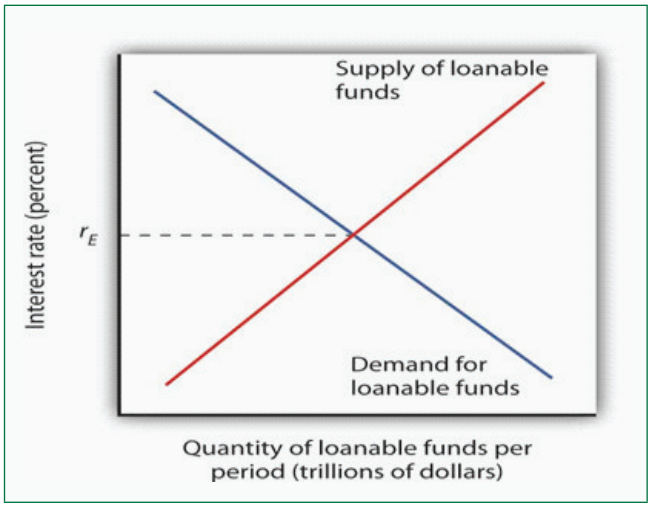



**Figure 5.8** The demand and supply of loanable funds

At lower interest rates, firms demand more capital and therefore more loanable funds. The demand for loanable funds is downward-sloping. The supply of loanable funds is generally upward-sloping. The equilibrium interest rate, rE, will be found where the two curves intersect.

Thus the demand for loanable funds is downward-sloping, like the demand for virtually everything else, as shown in **Figure 5.8**. The lower the interest rate, the more capital firms will demand. The more capital that firms demand, the greater the funding that is required to finance it.

## The supply of loanable funds

Lenders are consumers or firms that decide that they are willing to forgo some current use of their funds in order to have more available in the future. Lenders supply funds to the loanable funds market. In general, higher interest rates make the lending option more attractive.

For consumers, however, the decision is a bit more complicated than it is for firms. In examining consumption choices across time, economists think of consumers as having an expected stream of income over their lifetimes. It is that expected income that defines their consumption possibilities. The problem for consumers is to determine when to consume this income. They can spend less of their projected income now and thus have more available in the future. Alternatively, they can boost their current spending by borrowing against their future income.

Saving is income not spent on consumption. (We shall ignore taxes in this analysis.) Dissaving occurs when consumption exceeds income during a period. Dissaving means that the individual's saving is negative. Dissaving can be financed either by borrowing or by using past savings. Many people, for example, save in preparation for retirement and then dissave during their retirement years.

Saving adds to a household's wealth. Dissaving reduces it. Indeed, a household's wealth is the sum of the value of all past saving less all past dissaving.

We can think of saving as a choice to postpone consumption. Because interest rates are a payment paid to people who postpone their use of wealth, interest rates are a kind of reward paid to savers. Will higher interest rates encourage the behaviour they reward? The answer is a resounding "maybe". Just as higher wages might not increase the quantity of labour supplied, higher interest rates might not increase the quantity of saving. The problem, once again, lies in the fact that the income and substitution effects of a change in interest rates will pull in opposite directions.

Consider a hypothetical consumer, Tom Smith. Let us simplify the analysis of Mr. Smith's choices concerning the timing of consumption by assuming that there are only two periods: the present period is period 0, and the next is period 1. Suppose the interest rate is 8% and his income in both periods is expected to be RM30,000.

Mr. Smith could, of course, spend RM30,000 in period 0 and RM30,000 in period 1. In that case, his saving equals zero in both periods. But he has alternatives. He could, for example, spend more than RM30,000 in period 0 by borrowing against his income for period 1. Alternatively, he could spend less than RM30,000 in period 0 and use his saving — and the interest he earns on that saving — to boost his consumption in period 1. If, for example, he spends RM20,000 in period 0, his saving in period 0 equals RM10,000. He will earn RM800 interest on that saving, so he will have RM40,800 to spend in the next period.

Suppose the interest rate rises to 10%. The increase in the interest rate has boosted the price of current consumption. Now for every RM1 he spends in period 0 he gives up RM1.10 in consumption in period 1, instead of RM1.08, which was the amount that would have been given up in consumption in period 1 when the interest rate was 8%. A higher price produces a substitution effect that reduces an activity — Mr. Smith will spend less in the current period due to the substitution effect. The substitution effect of a higher interest rate thus boosts saving. But the higher interest rate also means that he earns more income on his saving. Consumption in the current period is a normal good, so an increase in income can be expected to increase current consumption. But an increase in current consumption implies a reduction in saving. The income effect of a higher interest rate thus tends to reduce saving. Whether Mr. Smith's saving will rise or fall in response to a higher interest rate depends on the relative strengths of the substitution and income effects.

To see how an increase in interest rates might reduce saving, imagine that Mr. Smith has decided that his goal is to have RM40,800 to spend in period 1. At an interest rate of 10%, he can reduce his saving below RM10,000 and still achieve his goal of having RM40,800 to spend in the next period. The income effect of the increase in the interest rate has reduced his saving, and consequently his desire to supply funds to the loanable funds market.

Because changes in interest rates produce substitution and income effects that pull saving in opposite directions, we cannot be sure what will happen to saving if interest rates change. The combined effect of all consumers' and firms' decisions, however, generally leads to an upward-sloping supply curve for loanable funds, as shown in **Figure 5.8**. That is, the substitution effect usually dominates the income effect.

The equilibrium interest rate is determined by the intersection of the demand and supply curves in the market for loanable funds.

## Capital and the loanable funds market

If the quantity of capital demanded varies inversely with the interest rate, and if the interest rate is determined in the loanable funds market, then it follows that the demand for capital and the loanable funds market are interrelated. Because the acquisition of new capital is generally financed in the loanable funds market, a change in the demand for capital leads to a change in the demand for loanable funds — and that affects the interest rate. A change in the interest rate, in turn, affects the quantity of capital demanded on any demand curve.

The relationship between the demand for capital and the loanable funds market thus goes both ways. Changes in the demand for capital affect the loanable funds market, and changes in the loanable funds market can affect the quantity of capital demanded.

## Changes in the demand for capital and the loanable funds market

**Figure 5.9** suggests how an increased demand for capital by firms will affect the loanable funds market, and thus the quantity of capital firms will demand. In Panel (a) the initial interest rate is r1. At $r_1$ in Panel (b) $K_1$ units of capital are demanded (on curve $D_1$). Now suppose an improvement in technology increases the marginal product of capital, shifting the demand curve for capital in Panel (b) to the right to $D_2$. Firms can be expected to finance the increased acquisition of capital by demanding more loanable funds, shifting the demand curve for loanable funds to $D_2$ in Panel (a). The interest rate thus rises to $r_2$. Consequently, in the market for capital the demand for capital is greater and the interest rate is higher. The new quantity of capital demanded is $K_2$ on demand curve $D_2$.

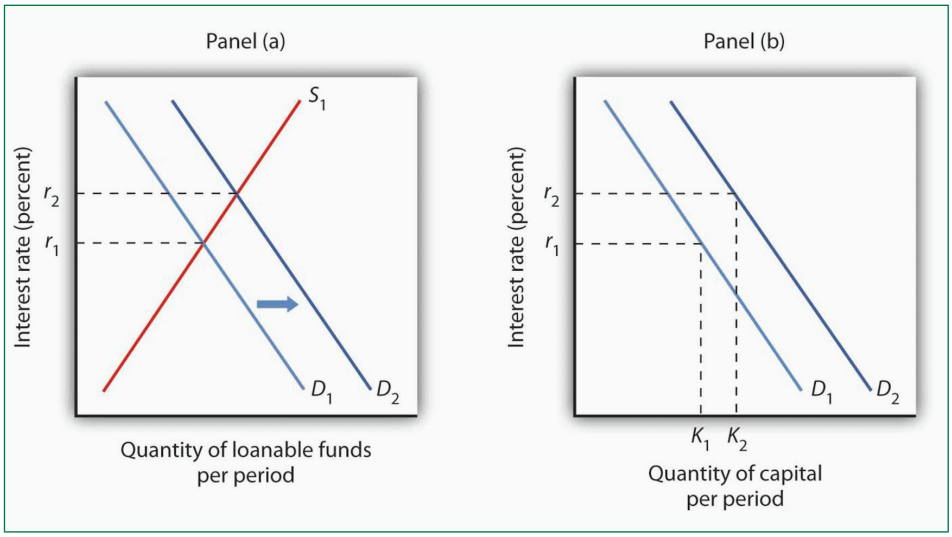



**Figure 5.9** Loanable funds and the demand for capital

The interest rate is determined in the loanable funds market, and the quantity of capital demanded varies with the interest rate. Thus, events in the loanable funds market and the demand for capital are interrelated. If the demand for capital increases to $D_2$ in Panel (b), the demand for loanable funds is likely to increase as well. Panel (a) shows the result in the loanable funds market — a shift in the demand curve for loanable funds from $D_1$ to $D_2$ and an increase in the interest rate from $r_1$ to $r_2$. At $r_2$, the quantity of capital demanded will be $K_2$, as shown in Panel (b).

## Changes in the loanable funds market and the demand for capital

Events in the loanable funds market can also affect the quantity of capital firms will hold. Suppose, for example, that consumers decide to increase current consumption and thus to supply fewer funds to the loanable funds market at any interest rate. This change in consumer preferences shifts the supply curve for loanable funds in Panel (a) of **Figure 5.10** from $S_1$ to $S_2$ and raises the interest rate to $r_2$. If there is no change in the demand for capital $D_1$, the quantity of capital firms demand falls to $K_2$ in Panel (b).

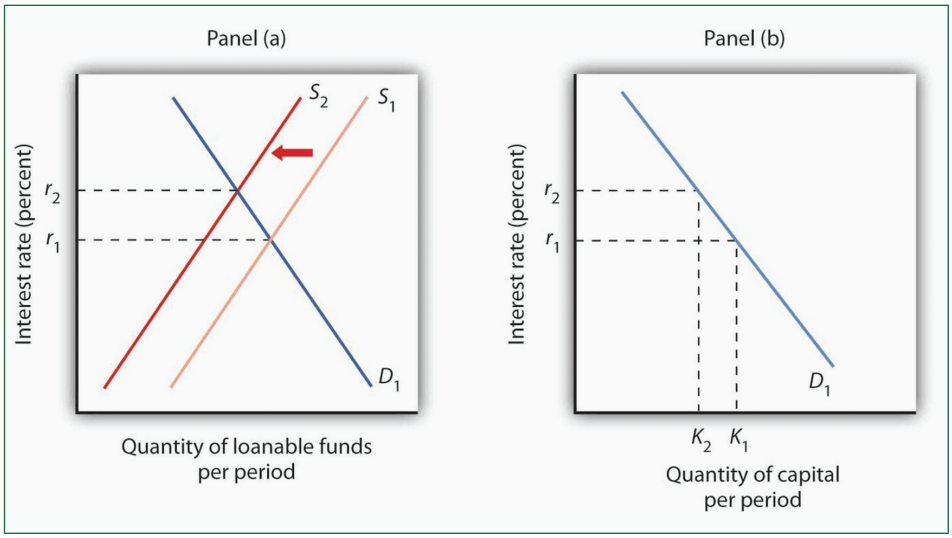



**Figure 5.10** A change in the loanable funds market and the quantity of capital demanded

A change that begins in the loanable funds market can affect the quantity of capital firms demand. Here, a decrease in consumer saving causes a shift in the supply of loanable funds from $S_1$ to $S_2$ in Panel (a). Assuming there is no change in the demand for capital, the quantity of capital demanded falls from $K_1$ to $K_2$ in Panel (b).

Our model of the relationship between the demand for capital and the loanable funds market thus assumes that the interest rate is determined in the market for loanable funds. Given the demand curve for capital, that interest rate then determines the quantity of capital firms' demand.

A change in the quantity of capital that firms demand can begin with a change in the demand for capital or with a change in the demand for or supply of loanable funds. A change in the demand for capital affects the demand for loanable funds and hence the interest rate in the loanable funds market. The change in the interest rate leads to a change in the quantity of capital demanded. Alternatively, a change in the loanable funds market, which leads to a change in the interest rate, causes a change in quantity of capital demanded. A change in the quantity of capital that firms demand can begin with a change in the demand for capital or with a change in the demand or supply of loanable funds.

## Summary

The demand curve for capital shows that firms demand a greater quantity of capital at lower interest rates. Among the forces that can shift the demand curve for capital are changes in expectations, changes in technology, changes in the demands for goods and services, changes in relative factor prices, and changes in tax policy. The interest rate is determined in the market for loanable funds. The demand curve for loanable funds has a negative slope; the supply curve has a positive slope. Changes in the demand for capital affect the loanable funds market, and changes in the loanable funds market affect the quantity of capital demanded.

## Self-test 5.4

Suppose that baby boomers become increasingly concerned about whether or not the government will really have the funds to make Social Security payments to them over their retirement years. As a result, they boost saving now. How would their decisions affect the market for loanable funds and the demand curve for capital?

# 5.3 Natural Resources and Conservation

## Objectives

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

1. Distinguish between exhaustible and renewable natural resources.
2. Discuss the market for exhaustible natural resources in terms of factors that influence both demand and supply.
3. Discuss the market for renewable natural resources and relate the market outcome to carrying capacity.
4. Explain and illustrate the concept of economic rent.

## Introduction

Natural resources are the gifts of nature. They include everything from oil to fish in the sea to magnificent scenic vistas. The stock of a natural resource is the quantity of the resource with which the earth is endowed. For example, a certain amount of oil lies in the earth, a certain population of fish live in the sea, and a certain number of acres make up an area such as Yellowstone National Park or Manhattan. These stocks of natural resources, in turn, can be used to produce a flow of goods and services. Each year, we can extract a certain quantity of oil, harvest a certain quantity of fish, and enjoy a certain number of visits to Yellowstone.

As with capital, we examine the allocation of natural resources among alternative uses across time. By definition, natural resources cannot be produced. Our consumption of the services of natural resources in one period can affect their availability in future periods. We must thus consider the extent to which the expected demands of future generations should be taken into account when we allocate natural resources.

Natural resources often present problems of property rights in their allocation. A resource for which exclusive property rights have not been defined will be allocated as a common property resource. In such a case, we expect that the marketplace will not generate incentives to use the resource efficiently. In the absence of government intervention, natural resources that are common property may be destroyed. In this section, we shall consider natural resources for which exclusive property rights have been defined. The public sector's role in the allocation of common property resources is investigated in the chapter on the environment.

We can distinguish two categories of natural resources, those that are renewable and those that are not. A renewable natural resource is one whose services can be used in one period without necessarily reducing the stock of the resource that will be

available in subsequent periods. The fact that they can be used in such a manner does not mean that they will be; renewable natural resources can be depleted. Wilderness areas, land, and water are renewable natural resources. The consumption of the services of an exhaustible natural resource, on the other hand, necessarily reduces the stock of the resource. Oil and coal are exhaustible natural resources.

## Exhaustible natural resources

Owners of exhaustible natural resources can be expected to take the interests of future as well as current consumers into account in their extraction decisions. The greater the expected future demand for an exhaustible natural resource, the greater will be the quantity preserved for future use.

Suppose you are the exclusive owner of a deposit of oil in Wyoming. You know that any oil you pump from this deposit and sell cannot be replaced. You are aware that this is true of all the world's oil; the consumption of oil inevitably reduces the stock of this resource.

If the quantity of oil in the earth is declining and the demand for this oil is increasing, then it is likely that the price of oil will rise in the future. Suppose you expect the price of oil to increase at an annual rate of 15%.

Given your expectation, should you pump some of your oil out of the ground and sell it? To answer that question, you need to know the interest rate. If the interest rate is 10%, then your best alternative is to leave your oil in the ground. With oil prices expected to rise 15% per year, the dollar value of your oil will increase faster if you leave it in the ground than if you pump it out, sell it, and purchase an interest-earning asset. If the market interest rate were greater than 15%, however, it would make sense to pump the oil and sell it now and use the revenue to purchase an interest-bearing asset. The return from the interest-earning asset, say 16%, would exceed the 15% rate at which you expect the value of your oil to increase. Higher interest rates thus reduce the willingness of resource owners to preserve these resources for future use.

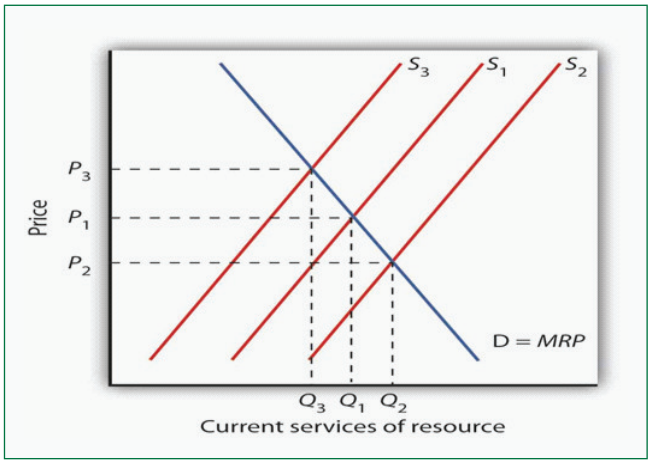



**Figure 5.11** Future generations and exhaustible natural resources

The current demand D for services of an exhaustible resource is given by the marginal revenue product (*MRP*). $S_1$ reflects the current marginal cost of extracting the resource, the prevailing interest rate, and expectations of future demand for the resource. The level of current consumption is thus at $Q_1$. If the interest rate rises, the supply curve shifts to $S_2$, causing the price of the resource to fall to $P_2$ and the quantity consumed to rise to $Q_2$. A drop in the interest rate shifts the supply curve to $S_3$, leading to an increase in price to P3 and a decrease in consumption to $Q_3$.

The supply of an exhaustible resource such as oil is thus governed by its current price, its expected future price, and the interest rate. An increase in the expected future price — or a reduction in the interest rate — reduces the supply of oil today, preserving more for future use. If owners of oil expect lower prices in the future, or if the interest rate rises, they will supply more oil today and conserve less for future use. This relationship is illustrated in **Figure 5.11**. The current demand *D* for these services is given by their marginal revenue product (*MRP*). Suppose $S_1$ reflects the current marginal cost of extracting the resource, the prevailing interest rate, and expectations of future demand for the resource. If the interest rate increases, owners will be willing to supply more of the natural resource at each price, thereby shifting the supply curve to the right to $S_2$. The current price of the resource will fall. If the interest rate falls, the supply curve for the resource will shift to the left to $S_3$ as more owners of the resource decide to leave more of the resource in the earth. As a result, the current price rises.

## Renewable natural resources

As is the case with exhaustible natural resources, our consumption of the services of renewable natural resources can affect future generations. Unlike exhaustible resources, however, renewable resources can be consumed in a way that does not diminish their stocks.

The quantity of a renewable natural resource that can be consumed in any period without reducing the stock of the resource available in the next period is its carrying capacity. Suppose, for example, that a school of 10 million fish increases by 1 million fish each year. The carrying capacity of the school is therefore 1 million fish per year — the harvest of 1 million fish each year will leave the size of the population unchanged. Harvests that exceed a resource's carrying capacity reduce the stock of the resource; harvests that fall short of it increase that stock.

As is the case with exhaustible natural resources, future generations have a stake in current consumption of a renewable resource. **Figure 5.12** shows the efficient level of consumption of such a resource. Suppose $Q_{cap}$ is the carrying capacity of a particular resource and $S_1$ is the supply curve that reflects the current marginal cost of utilising the resource, including costs for the labour and capital required to make its services available, given the interest rate and expected future demand. The efficient level of consumption in the current period is found at point E, at the intersection of the current period's demand and supply curves. Notice that in the case shown, current consumption at $Q_1$ is less than the carrying capacity of the resource. A larger stock of this resource will be available in subsequent periods than is available now.

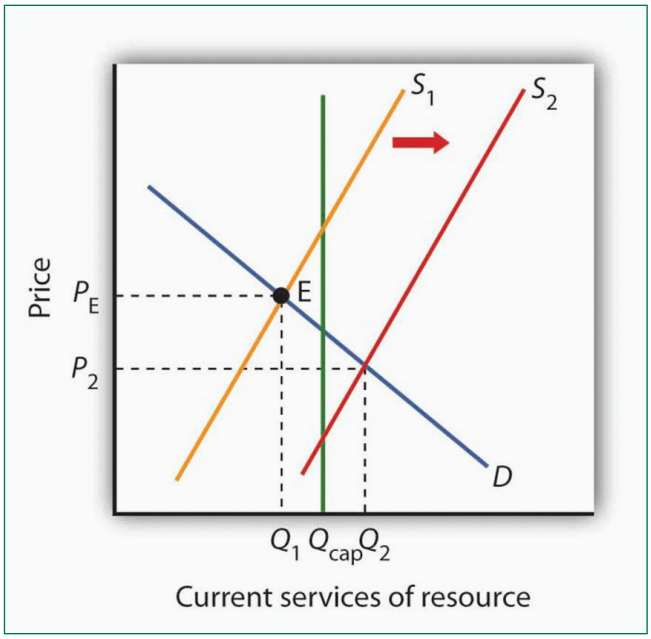



**Figure 5.12** Future generations and renewable resources

The efficient quantity of services to consume is determined by the intersection $S_1$ and the demand curve $D$. This intersection occurs at point $E$ at a quantity of $Q_1$. This lies below the carrying capacity $Q_{cap}$. An increase in interest rates, however, shifts the supply curve to $S_2$. The efficient level of current consumption rises to $Q_2$, which now exceeds the carrying capacity of the resource.

Now suppose interest rates increase. Much like non-renewable resources, higher interest rates shift the supply curve to the right, as shown by $S_2$. The result is an increase in current consumption to $Q_2$. Now consumption exceeds the carrying capacity, and the stock of the resource available to future generations will be reduced. While this solution may be efficient, the resource will not be sustained over time at current levels.

If society is concerned about a reduction in the amount of the resource available in the future, further steps may be required to preserve it. For example, if trees are being cut down faster than they are being replenished in a particular location, such as the Amazon in Brazil, a desire to maintain biological diversity might lead to conservation efforts.

## Economic rent and the market for land

We turn finally to the case of land that is used solely for the space it affords for other activities — parks, buildings, golf courses, and so forth. We shall assume that the carrying capacity of such land equals its quantity.

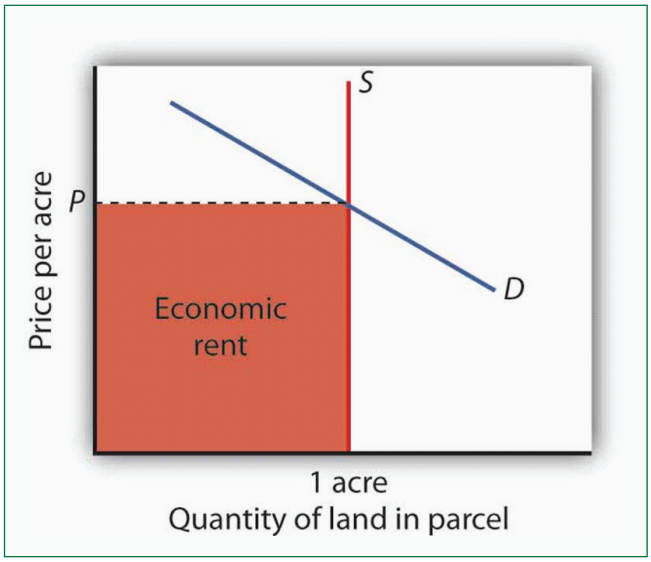



**Figure 5.13** The market for land

The price of a one-acre parcel of land is determined by the intersection of a vertical supply curve and the demand curve for the parcel. The sum paid for the parcel, shown by the shaded area, is economic rent.

The supply of land is a vertical line. The quantity of land in a particular location is fixed. Suppose, for example, that the price of a one-acre parcel of land is zero. At a price of zero, there is still one acre of land; quantity is unaffected by price. If the price were to rise, there would still be only one acre in the parcel. That means that the price of the parcel exceeds the minimum price — zero — at which the land would be available. The amount by which any price exceeds the minimum price necessary to make a resource available is called economic rent.

The concept of economic rent can be applied to any factor of production that is in fixed supply above a certain price. In this sense, much of the salary received by Brad Pitt constitutes economic rent. At a low enough salary, he might choose to leave the entertainment industry. How low would depend on what he could earn in a best alternative occupation. If he earns RM30 million per year now but could earn RM100,000 in a best alternative occupation, then RM29.9 million of his salary is economic rent. Most of his current earnings are in the form of economic rent, because his salary substantially exceeds the minimum price necessary to keep him supplying his resources to current purposes.

## Summary

Natural resources are either exhaustible or renewable. The demand for the services of a natural resource in any period is given by the marginal revenue product of those services. Owners of natural resources have an incentive to take into account the current price, the expected future demand for them, and the interest rate when making choices about resource supply. The services of a renewable natural resource may be consumed at levels that are below or greater than the carrying capacity of the resource. The payment for a resource above the minimum price necessary to make the resource available is economic rent.

## Self-test 5.5

You have just been given an oil well in Miri by Aunt Carmen. The current price of oil is RM45 per barrel, and it is estimated that your oil deposit contains about 10,000 barrels of oil. For simplicity, assume that it does not cost anything to extract the oil and get it to market and that you must decide whether to empty the well now or wait until next year. Suppose the interest rate is 10% and that you expect that the price of oil next year will rise to RM54 per barrel. What should you do?

# 5.4 Market Failure

## Objectives

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

1. Explain what is meant by market failure and the conditions that may lead to it.

2. Distinguish between private goods and public goods and relate them to the free rider problem and the role of government.

3. Explain the concepts of external costs and benefits and the role of government intervention when they are present.

4. Explain why a common property resource is unlikely to be allocated efficiently in the marketplace.

## Introduction

Private decisions in the marketplace may not be consistent with the maximization of the net benefit of a particular activity. The failure of private decisions in the marketplace to achieve an efficient allocation of scarce resources is called market failure. Markets will not generate an efficient allocation of resources if they are not competitive or if property rights are not well defined and fully transferable. Either condition will mean that decision makers are not faced with the marginal benefits and costs of their choices.

Think about the drive that we had you take at the beginning of this chapter. You faced some, but not all, of the opportunity costs involved in that choice. In particular, your choice to go for a drive would increase air pollution and might increase traffic congestion. That means that, in weighing the marginal benefits and marginal costs of going for a drive, not all of the costs would be counted. As a result, the net benefit of the allocation of resources such as the air might not be maximised.

## Non-competitive markets

The model of demand and supply assumes that markets are competitive. No one in these markets has any power over the equilibrium price; each consumer and producer takes the market price as given and responds to it. Under such conditions, price is determined by the intersection of demand and supply.

In some markets, however, individual buyers or sellers are powerful enough to influence the market price. In subsequent chapters, we will study cases in which producers or consumers are in a position to affect the prices they charge or must pay, respectively. We shall find that when individual firms or groups of firms have

market power, which is the ability to change the market price, the price will be distorted — it will not equal marginal cost.

## Public goods

Some goods are unlikely to be produced and exchanged in a market because of special characteristics of the goods themselves. The benefits of these goods are such that exclusion is not feasible. Once they are produced, anyone can enjoy them; there is no practical way to exclude people who have not paid for them from consuming them. Furthermore, the marginal cost of adding one more consumer is zero. A good for which the cost of exclusion is prohibitive and for which the marginal cost of an additional user is zero is a public good. A good for which exclusion is possible and for which the marginal cost of another user is positive is a private good.

National defence is a public good. Once defence is provided, it is not possible to exclude people who have not paid for it from its consumption. Further, the cost of an additional user is zero — an army does not cost any more if there is one more person to be protected. Other examples of public goods include law enforcement, fire protection, and efforts to preserve species threatened with extinction.

## Free riders

Suppose a private firm, Terror Alert, Inc., develops a completely reliable system to identify and intercept 98% of any would-be terrorists that might attempt to enter the United States from anywhere in the world. This service is a public good. Once it is provided, no one can be excluded from the system's protection on grounds that he or she has not paid for it, and the cost of adding one more person to the group protected is zero. Suppose that the system, by eliminating a potential threat to U.S. security, makes the average person in the United States better off; the benefit to each household from the added security is worth RM40 per month (about the same as an earthquake insurance premium). There are roughly 113 million households in the United States, so the total benefit of the system is RM4.5 billion per month. Assume that it will cost Terror Alert, Inc., RM1 billion per month to operate. The benefits of the system far outweigh the cost.

Suppose that Terror Alert installs its system and sends a bill to each household for RM20 for the first month of service — an amount equal to half of each household's benefit. If each household pays its bill, Terror Alert will enjoy a tidy profit; it will receive revenues of more than RM2.25 billion per month.

But will each household pay? Once the system is in place, each household would recognise that it will benefit from the security provided by Terror Alert whether it pays its bill or not. Although some households will voluntarily pay their bills, it seems unlikely that very many will. Recognising the opportunity to consume the good without paying for it, most would be free riders. Free riders are people or firms that consume a public good without paying for it. Even though the total benefit of the system is RM4.5 billion, Terror Alert will not be faced by the marketplace with

a signal that suggests that the system is worthwhile. It is unlikely that it will recover its cost of RM1 billion per month. Terror Alert is not likely to get off the ground.

The bill for RM20 from Terror Alert sends the wrong signal, too. An efficient market requires a price equal to marginal cost. But the marginal cost of protecting one more household is zero; adding one more household adds nothing to the cost of the system. A household that decides not to pay Terror Alert anything for its service is paying a price equal to its marginal cost. But doing that, being a free rider, is precisely what prevents Terror Alert from operating.

Because no household can be excluded and because the cost of an extra household is zero, the efficiency condition will not be met in a private market. What is true of Terror Alert, Inc., is true of public goods in general: they simply do not lend themselves to private market provision.

## Public goods and the government

Because many individuals who benefit from public goods will not pay for them, private firms will produce a smaller quantity of public goods than is efficient, if they produce them at all. In such cases, it may be desirable for government agencies to step in. Government can supply a greater quantity of the good by direct provision, by purchasing the public good from a private agency, or by subsidising consumption. In any case, the cost is financed through taxation and thus avoids the free-rider problem.

Most public goods are provided directly by government agencies. Governments produce national defence and law enforcement, for example. Private firms under contract with government agencies produce some public goods. Park maintenance and fire services are public goods that are sometimes produced by private firms. In other cases, the government promotes the private consumption or production of public goods by subsidising them. Private charitable contributions often support activities that are public goods; federal and state governments subsidise these by allowing taxpayers to reduce their tax payments by a fraction of the amount they contribute.

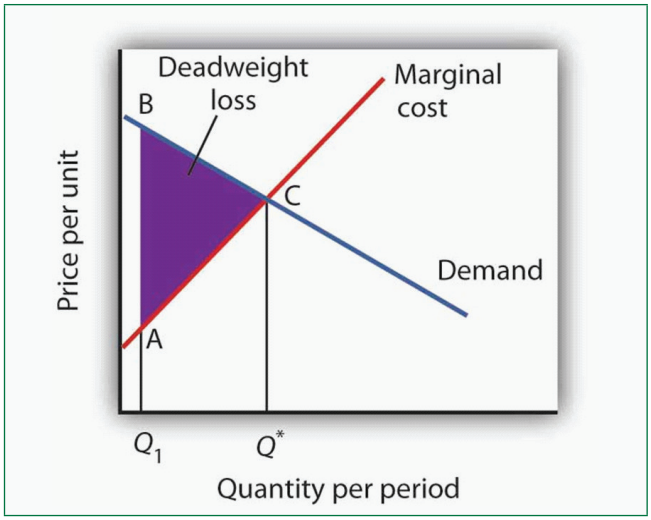



**Figure 5.14** Public goods and market failure

Because free riders will prevent firms from being able to require consumers to pay for the benefits received from consuming a public good, output will be less than the efficient level. In the case shown here, private donations achieved a level of the public good of $Q_1$ per period. The efficient level is Q*. The deadweight loss is shown by the triangle ABC.

While the market will produce some level of public goods in the absence of government intervention, we do not expect that it will produce the quantity that maximises net benefit. **Figure 5.14** illustrates the problem. Suppose that provision of a public good such as national defence is left entirely to private firms. It is likely that some defence services would be produced; suppose that equals $Q_1$ units per period. This level of national defence might be achieved through individual contributions. But it is very unlikely that contributions would achieve the correct level of defence services. The efficient quantity occurs where the demand, or marginal benefit, curve intersects the marginal cost curve, at $Q^*$. The deadweight loss is the shaded area ABC; we can think of this as the net benefit of government intervention to increase the production of national defence from $Q_1$ up to the efficient quantity, $Q^*$.

Note that the definitions of public and private goods are based on characteristics of the goods themselves, not on whether they are provided by the public or the private sector. Postal services are a private good provided by the public sector. The fact that these goods are produced by a government agency does not make them a public good.

## External costs and benefits

Suppose that in the course of production, the firms in a particular industry generate air pollution. These firms thus impose costs on others, but they do so outside the context of any market exchange — no agreement has been made between the firms and the people affected by the pollution. The firms thus will not be faced with the costs of their action. A cost imposed on others outside of any market exchange is an external cost.

We saw an example of an external cost in our imaginary decision to go for a drive. Here is another: violence on television, in the movies, and in video games. Many critics argue that the violence that pervades these media fosters greater violence in the real world. By the time a child who spends the average amount of time watching television finishes elementary school, he or she will have seen 100,000 acts of violence, including 8,000 murders, according to the American Psychological Association. Thousands of studies of the relationship between violence in the media and behaviour have concluded that there is a link between watching violence and violent behaviours. Video games are a major element of the problem, as young children now spend hours each week playing them. Fifty percent of fourth-grade graders say that their favourite video games are the "first person shooter" type.

Any tendency of increased violence resulting from increased violence in the media constitutes an external cost of such media. The American Academy of Pediatrics reported in 2001 that homicides were the fourth leading cause of death among children between the ages of 10 and 14 and the second leading cause of death for people aged 15 to 24 and has recommended a reduction in exposure to media

violence. It seems reasonable to assume that at least some of these acts of violence can be considered an external cost of violence in the media.

An action taken by a person or firm can also create benefits for others, again in the absence of any market agreement; such a benefit is called an external benefit. A firm that builds a beautiful building generates benefits to everyone who admires it; such benefits are external.

## External costs and efficiency

One important issue with external costs is that it affects the overall efficiency of the market. When firms in an industry generate external costs, the supply curve $S_1$ reflects only their private marginal costs, *MCP*. Forcing firms to pay the external costs they impose shifts the supply curve to $S_2$, which reflects the full marginal cost of the firms' production, $MC_e$. Output is reduced and price goes up. The deadweight loss that occurs when firms are not faced with the full costs of their decisions is shown by the shaded area in **Figure 5.15**.

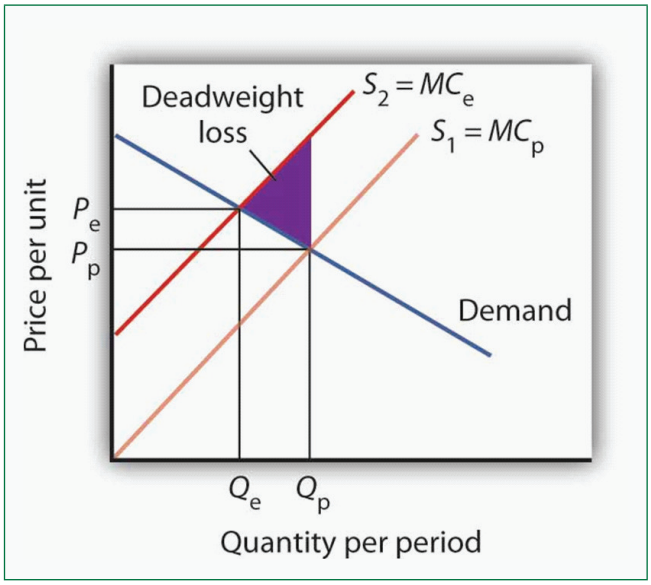



**Figure 5.15** External costs

The case of the polluting firms is illustrated in **Figure 5.15**. The industry supply curve $S_1$ reflects private marginal costs, $MC_p$. The market price is $P_p$ for a quantity $Q_p$. This is the solution that would occur if firms generating external costs were not forced to pay those costs. If the external costs generated by the pollution were added, the new supply curve $S_2$ would reflect higher marginal costs, $MC_e$. Faced with those costs, the market would generate a lower equilibrium quantity, $Q_e$. That quantity would command a higher price, $P_e$. The failure to confront producers with the cost of their pollution means that consumers do not pay the full cost of the good they are purchasing. The level of output and the level of pollution are therefore higher than would be economically efficient. If a way could be found to confront producers with the full cost of their choices, then consumers would be faced with a higher cost as well. **Figure 5.15** shows that consumption would be reduced to the efficient

level, $Q_e$, at which demand and the full marginal cost curve ($MC_e$) intersect. The deadweight loss generated by allowing the external cost to be generated with an output of $Q_p$ is given as the shaded region in the graph.

## External costs and government intervention

If an activity generates external costs, the decision makers generating the activity will not be faced with its full costs. Agents who impose these costs will carry out their activities beyond the efficient level; those who consume them, facing too low a price, will consume too much. As a result, producers and consumers will carry out an excessive quantity of the activity. In such cases, government may try to intervene to reduce the level of the activity toward the efficient quantity. In the case shown in **Figure 5.15**, for example, firms generating an external cost have a supply curve $S_1$ that reflects their private marginal costs, $MC_p$. A per-unit pollution fee imposed on the firms would increase their marginal costs to $MC_e$, thus shifting the supply curve to $S_2$, and the efficient level of production would emerge. Taxes or other restrictions may be imposed on the activity that generates the external cost in an effort to confront decision makers with the costs that they are imposing. In many areas, firms and consumers that pollute rivers and lakes are required to pay fees based on the amount they pollute. Firms in many areas are required to purchase permits in order to pollute the air; the requirement that permits be purchased serves to confront the firms with the costs of their choices.

Another approach to dealing with problems of external costs is direct regulation. For example, a firm may be ordered to reduce its pollution. A person who turns his or her front yard into a garbage dump may be ordered to clean it up. Participants at a raucous party may be told to be quiet. Alternative ways of dealing with external costs are discussed later in the text.

## Common property resources

Common property resources are sometimes referred to as open access resources. Common property resources are resources for which no property rights have been defined. The difficulty with common property resources is that individuals may not have adequate incentives to engage in efforts to preserve or protect them. Consider, for example, the relative fates of cattle and buffalo in the United States in the nineteenth century. Cattle populations increased throughout the century, while the buffalo nearly became extinct. The chief difference between the two animals was that exclusive property rights existed for cattle but not for buffalo. The same can be said for the number of tigers in the Malaysian jungles versus chickens in farms.

Owners of cattle had an incentive to maintain herd sizes. A cattle owner who slaughtered all of his or her cattle without providing for replacement of the herd would not have a source of future income. Cattle owners not only maintained their herds but also engaged in extensive efforts to breed high-quality livestock. They invested time and effort in the efficient management of the resource on which their livelihoods depended.

Buffalo hunters surely had similar concerns about the maintenance of buffalo herds, but they had no individual stake in doing anything about them — the animals were a common property resource. Thousands of individuals hunted buffalo for a living. Anyone who cut back on hunting in order to help to preserve the herd would lose income — and face the likelihood that other hunters would go on hunting at the same rate as before.

Today, exclusive rights to buffalo have been widely established. The demand for buffalo meat, which is lower in fat than beef, has been increasing, but the number of buffalo in the United States is rising rapidly. If buffalo were still a common property resource, that increased demand, in the absence of other restrictions on hunting of the animals, would surely result in the elimination of the animal. Because there are exclusive, transferable property rights in buffalo and because a competitive market brings buyers and sellers of buffalo and buffalo products together, we can be reasonably confident in the efficient management of the animal.

When a species is threatened with extinction, it is likely that no one has exclusive property rights to it. Whales, condors, grizzly bears, elephants in Central Africa are common property resources regardless which animal is threatened. In such cases a government agency may impose limits on the killing of the animal or destruction of its habitat. Such limits can prevent the excessive private use of a common property resource. Alternatively, as was done in the case of the buffalo, private rights can be established, giving resource owners the task of preservation.

## Summary

Public sector intervention to increase the level of provision of public goods may improve the efficiency of resource allocation by overcoming the problem of free riders. Activities that generate external costs are likely to be carried out at levels that exceed those that would be efficient; the public sector may seek to intervene to confront decision makers with the full costs of their choices. Some private activities generate external benefits. A common property resource is unlikely to be allocated efficiently in the marketplace.

**Self-test 5.6**

The manufacture of memory chips for computers generates pollutants that generally enter rivers and streams. Use the model of demand and supply to show the equilibrium price and output of chips. Assuming chip manufacturers do not have to pay the costs these pollutants impose, what can you say about the efficiency of the quantity of chips produced? Show the area of deadweight loss imposed by this external cost. Show how a requirement that firms pay these costs as they produce the chips would affect the equilibrium price and output of chips. Would such a requirement help to satisfy the efficiency condition? Explain.

# Summary of Unit 5

**Summary**

We started this unit by looking at the labour markets. Labour was placed in a perfectly competitive market as price takers to ease the comprehension level of students. This is also in keeping with current norms of microeconomics studies. Several factors that influence demand and supply were examined. A brief introduction to minimum wage was also included for good measure. We moved on to look at how capital and the loanable funds market works. The importance of interest rate to an entrepreneur was given fair treatment. Next we had a chance to discuss natural resources; both exhaustible and renewable. That brought us to economic rent and use of land. This unit ended with a discussion on market failure and public goods. The need to maintain our natural resources was described briefly.

# Course Summary

**Summary**

This course is an elementary level course in the suite of courses offered by the School of Business and Administration for its business programmes. It is also included in the Bachelor of Arts in Liberal Studies as a basic major. This course provides a basic understanding of the principles of microeconomics in the context of a business environment.

This course started with an introduction to basic principles of microeconomics. You were exposed to the concepts of microeconomics and macroeconomics. There were explanations given on the differences between normative and positive statements. There was also an introduction to the basic problems of economics including scarcity, the choices we make and opportunity costs.

Subsequent topics dealt with the demand and supply and how the market works. The market left alone may not be as efficient, forcing the interference of the government. You had the opportunity of studying about price ceilings, price floors, taxes and subsidies. There was also short introduction to the principles of elasticity and that works.

Profits can only be gotten if there is revenue and revenue needs production. Production, on the other hand, needs inputs which would incur costs. Unit 3 looks at the concepts of costs and production both in the short-run and long-run. This unit acts as an introductory passage to the rest of the units. Market structure in the forms of perfect competition, monopoly, monopolistic and oligopolistic markets is covered in subsequent units. A short exposure to the fundamentals of game theory is also provided in Unit 4.

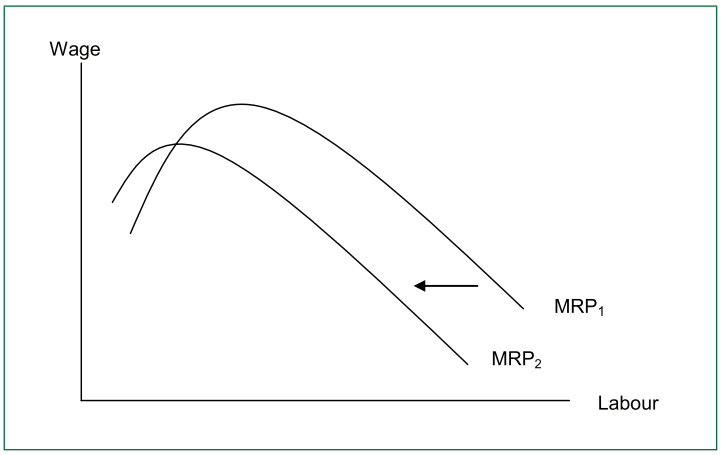
The course ended with a look at the factor markets, market failure and public goods. As mentioned earlier, markets may not be fully efficient. There are failures within the market that needs remedy. The effect on the environment is one such failure of the market. We saw how the external costs of production can be detrimental to the environment and what government can do to rectify this problem.

# Suggested Answers to Self-tests

## Feedback

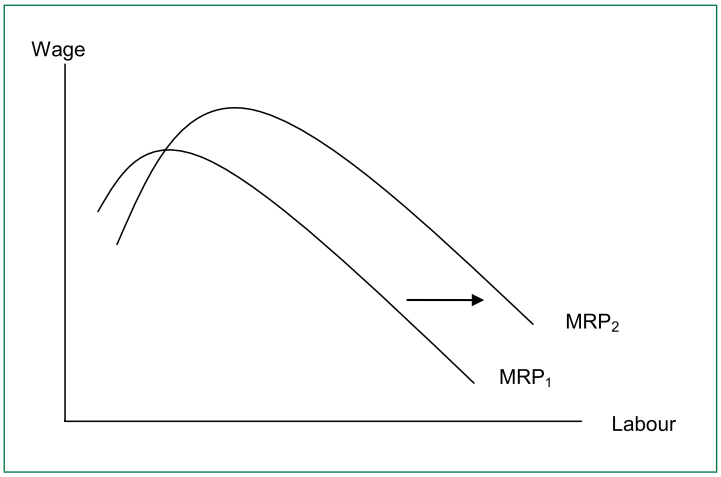
### Self-test 5.1

1. A reduction in market price would decrease the marginal revenue product of labour. Since the demand for labour is the downward — sloping portion of the marginal revenue product curve, the demand for labour by TeleTax would shift to the left.



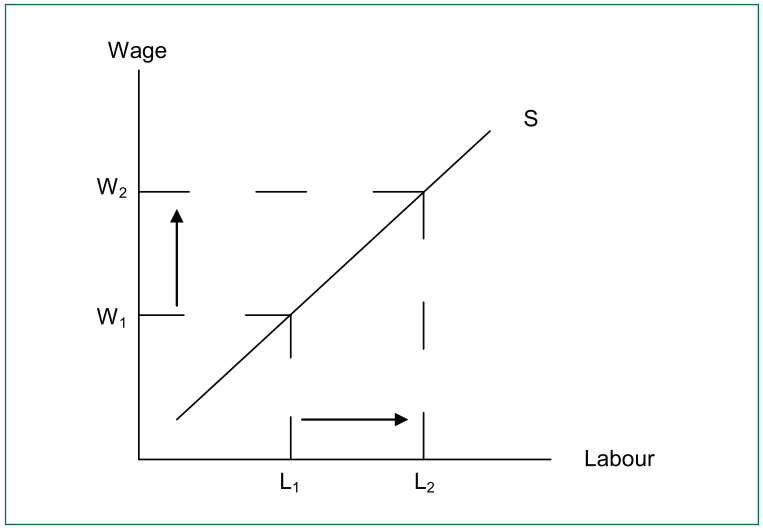

2. An increase in the market fee that TeleTax pays the accountants it hires corresponds to an increase in marginal factor cost. TeleTax's demand curve would not shift; rather TeleTax would move up along its same demand curve for accountants. As a result, TeleTax would hire fewer accountants.

3. An increase in the marginal product of each accountant corresponds to a rightward shift in the marginal revenue product curve and hence a rightward shift in TeleTax's demand curve for accountants.

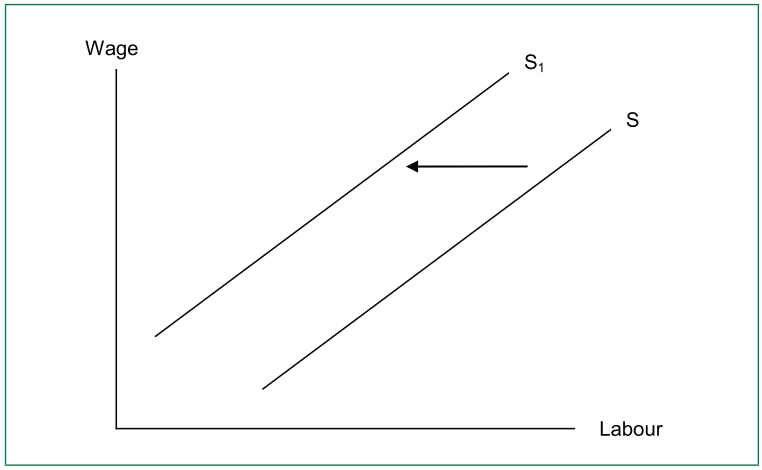



**Self-test 5.2**

The first question is about willingness to work as the wage rate changes. It thus refers to movement along the labour supply curve. That mothers of preschool-age children are more willing to work the higher the wage implies an upward-sloping labour supply curve. When the labour supply curve is upward sloping, the substitution effect dominates the income effect. The other three questions refer to factors that cause the labour supply curve to shift. In all three cases, the circumstances imply that the labour supply curve would shift to the left.



Increase in wage




An increase in the preference for a traditional family structure, an increased sense that child care is inferior to a mother's care and an increase in the cost of child care.

**Self-test 5.3**

1. An increase in the demand for new housing would shift the demand curve for construction workers to the right, as shown in **Figure 5.5**, Panel (a). Both the wage rate and the employment in construction rise.

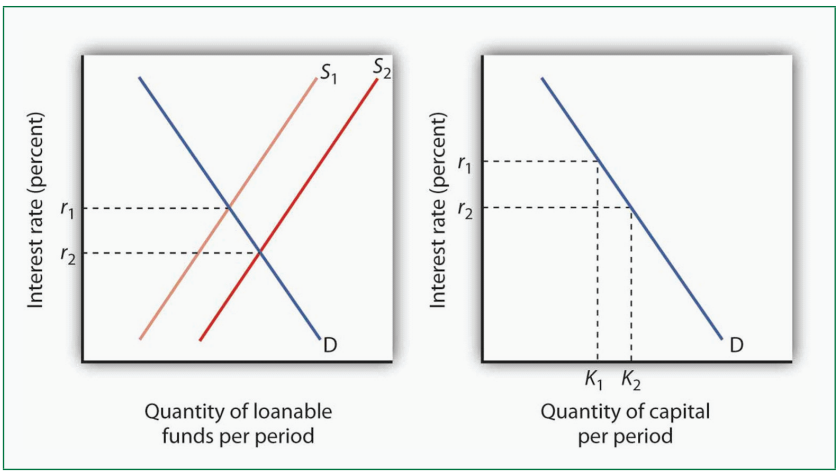
2. A larger number of women wanting to work in construction means an increase in labour supply, as shown in **Figure 5.5**, Panel (c). An increase in the supply of labour reduces the wage rate and increases employment.

3. Improved training would increase the marginal revenue product of construction workers and hence increase demand for them. Wages and employment would rise, as shown in **Figure 5.5**, Panel (a).

4. The robots are likely to serve as a substitute for labour. That will reduce demand, wages, and employment of construction workers, as shown in Panel (b) in **Figure 5.5**.

**Self-test 5.4**

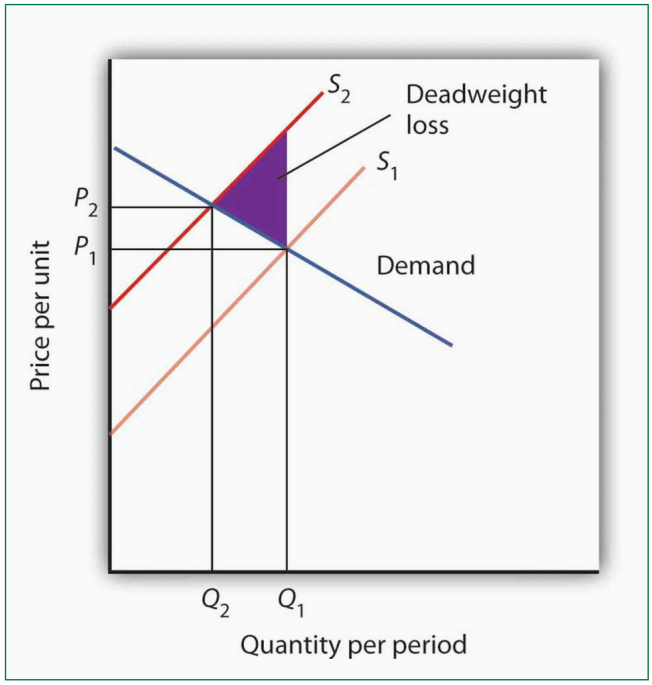
An increase in saving at each interest rate implies a rightward shift from $S_1$ to $S_2$ in the supply curve of loanable funds. As a result, the equilibrium interest rate falls from $r_1$ to $r_2$ . With the lower interest rate, there is movement downward to the right along the demand-for-capital curve, as shown.




**Self-test 5.5**

Since you expect oil prices to rise (RM54 – 45)/RM45 = 20% and the interest rate is only 10%, you would be better off waiting a year before emptying the well. You could also look at the solution using the present value method. Since that method is not covered in this course, we will ignore that.

**Self-test 5.6**




In the absence of any regulation, chip producers are not faced with the costs of the pollution their operations generate. The market price is thus $P_1$ and the quantity $Q_1$. The efficiency condition is not met; the price is lower and the quantity greater than would be efficient. If producers were forced to face the cost of their pollution as well as other production costs, the supply curve would shift to $S_2$, the price would rise to $P_2$, and the quantity would fall to $Q_2$. The new solution satisfies the efficiency condition.

# References

Cooper, R and John, A A (2011) *Microeconomics: Theory through Application,* Flatworld Knowledge http://catalog.flatworldknowledge.com/catalog/editions/coopermicro-microeconomics-theory-through-applications-1-0 (Accessed 16 January 2014).

Mankiw, N G et al. (2013) *Principles of Economics.* Malaysian edn, Cengage Learning Asia.

Mankiw, N G (2007) *Principles of Economics,* 3rd edn, Florida: Thomson South-Western.

Case, K E and Fair, R C (2003) *Principles of Economics,* 7th edn, US: Prentice Hall.

Irvin, T B (2005) *Economics for Today,* 4th edn, Ohio: South-Western Publishing Company.

Rittenberg, L and Tregarthen, T (2009) *Principles of Economics.* Flatworld Knowledge http://catalog.flatworldknowledge.com/catalog/editions/p1628 (Accessed 16 January 2014)

Stonecash et al. (2003) *Principles of Macroeconomics*, 2nd edn, Australia: South-Western Publishing Company.