

# Unit One: An Introduction to Environmental Economics and Economic Concepts

Unit Information	3
Unit Overview	3
Unit Aims	3
Unit Learning Outcomes	3
Unit Interdependencies	4
Key Readings	5
Further Readings	6
References	6
1.0 Introduction	7
Section Overview	7
Section Learning Outcomes	7
1.1 Defining economics and the environment	7
1.2 Links between the economy and the environment	8
1.3 The first two laws of thermodynamics	11
Section 1 Self Assessment Questions	13
2.0 Origins and scope of environmental economics	14
Section Overview	14
Section Learning Outcomes	14
2.1 Origins of environmental economics	14
2.2 Scope of the discipline	15
Section 2 Self Assessment Question	16
3.0 Basic economic principles	17
Section Overview	17
Section Learning Outcomes	17
3.1 Positive and normative economics	17
3.2 Applying scientific methods and reasoning	18
3.3 Terminology and basic concepts	20
Section 3 Self Assessment Questions	23

4.0 The neo-classical economic model	24
Section Overview	24
Section Learning Outcomes	24
4.1 Perfect competition	24
4.2 Methods of economic analysis	26
4.3 Demand	27
4.4 Supply	31
4.5 Supply and demand – finding the market equilibrium	31
4.6 Pareto Optimality	34
Section 4 Self Assessment Questions	37
5.0 An introduction to market failure and government failure	39
5.1 Market failure	39
5.2 Government failure	40
Section 5 Self Assessment Questions	42
Unit Summary	43
Unit Self Assessment Questions	44
Key Terms and Concepts	46

## UNIT INFORMATION

### Unit Overview

This unit provides an introduction to the meaning and scope of environmental economics. The unit explains why the discipline is important; the linkages between the economy and the environment; the origins and development of environmental economics; and the scope of the discipline. The unit then provides an overview of key economic issues and concepts that will be employed throughout the module.

### Unit Aims

- To explain how the economy and the environment are linked and the uses made of the environment by the economy.
- To set the discipline of environmental economics in context and to outline the scope of the discipline.
- To explain why markets fail and the resulting impact on the environment.
- To explain basic economic concepts and principles.

### Unit Learning Outcomes

By the end of this unit, students should:

- have gained a knowledge of the main interactions between the environment and the economy and the physical constraints that place limits on the interaction
- be familiar with the history of the discipline of environmental economics and what is included in the discipline
- have an understanding of the impact on the environment of market failure
- be familiar with core economic concepts and principles

## UNIT INTERDEPENDENCIES

### Unit 2

In Unit 2 we consider in detail why markets fail or do not exist, with particular reference to the environment. The link to the current unit is that many of the basic economic principles introduced are predicated on the markets working correctly. As will become apparent this is frequently not the case with respect to environmental resources.

### Unit 3

In Unit 3 we consider how standards and taxes can be employed to correct forms of market failure in order to help with the efficient allocation of resources. The link with this unit is that the objective of these environmental policies is that they are part of the possible portfolio of policy options available to rectify market failure.

### Unit 4

In Unit 4 we consider how subsidies and transferable permits can be used to rectify forms of market failure. Again, the link with this unit is that the policies considered are means to rectify market failure.

### Unit 5

In Unit 5 we consider aspects of environmental policy implementation. The link with this unit is that ensuring that the link between economy and environment is efficient requires any policy to be implemented effectively. Both the targeting of policy and its enforcement are key parts of this process in practice.

### Unit 6

In Unit 6 we examine issues of value as they relate to the environment. The link to this current unit is that it deepens our understanding of how the environment and natural resources interact with the economy and economic system in general.

### Unit 7

In Unit 7 we examine how existing markets can be used to reveal information about the value of the environment. These approaches to environmental valuation take a very specific approach to how the economy and the environment are linked.

### Unit 8

In Unit 8 we explain how we can derive very broad measures of value for the environment that extend how we consider the relationship of the economy and environment developed in the current unit.

### Unit 9

In Unit 9 we examine how measures of environmental value can be used in practice. The methods we examine can be used to help allocate environmental resources within the economic system. These methods provide a practical link between the economy and the environment.

### Unit 10

In Unit 10 we consider the meaning of sustainable development. The importance of sustainable development as an ideology-driving policy as well as a concept of resource use can be traced to the way in which researchers have considered the nature of the links between the economy and the environment.

## KEY READINGS

- ❖ Mulhearn C, Vane HR (2012) *Economics for Business*, 2nd edition. Palgrave Macmillan.

Chapter 1, Economics for Business, pages 1-26; Chapter 2, The Market, pages 27-69; Chapter 3, The Firm, pages 71-90; Chapter 5, Market Concentration and Power, pages 125-138; Chapter 6, Business and Government, pages 161-180.

These chapters or sections of chapters provide a useful introduction to many of the basic economic concepts introduced in this unit and later in the module. The material covered in these readings is intended to give students who have limited or no exposure to economic principles additional support with the concepts and ideas being introduced in this module. Students who are confident with microeconomics from prior study may find it is not necessary to read these chapters, although they may remain a useful resource for reference on specific points or for revision. As you read this material keep in mind the ideas of public and private perspectives. Is the analysis telling us how private individuals or businesses behave? Will this explain how resources are allocated in an economy? Or is the analysis taking a public policy perspective to understand how things should be done for the welfare of society. Positive and normative, scarcity, opportunity cost and allocate efficiency are key concepts that you should understand from these readings.

---

- ❖ Tietenberg T, Lewis L (2014) *Environmental & Natural Resource Economics*, 9th edition. Pearson.

Chapter 1 provides a useful overview to many of the issues considered in the first unit. In particular, it considers the role that economics might play in environmental issues and how economics can help in this context. Chapter 3 is also highly relevant as it introduces and explains how the economy and the environment are linked. Chapter 3 also develops some of the basic principles that we introduce in Unit 1 making the link with their use in the environmental context clear. Many of the ideas introduced in these chapters will be developed in more detail as we go through the module.

---

## FURTHER READINGS

Common M, Stiglitz S (2005) *Ecological Economics. An Introduction*. Cambridge University Press.

---

Fullerton D, Stavins N (1998) How economists see the environment. *Nature* 395 433–434.

---

## REFERENCES

Common M, Stiglitz S (2005) *Ecological Economics. An Introduction*. Cambridge University Press.

---

Hanley N, Shogren JF, White B (2007) *Environmental Economics in Theory and Practice*, 2nd edition. Palgrave Macmillan.

---

Stern N (2007) *The Economics of Climate Change: The Stern Review*. Cambridge University Press, Cambridge.

---

## 1.0 INTRODUCTION

### Section Overview

In this section we begin by outlining the field of economics, environmental economics, and the role of this module within environmental economics. Specifically we develop a conceptual model of the relationship between the economy and the environment that places in context many of the activities undertaken by environmental economists, in particular, environmental policy design and implementation. The model we develop draws attention to some of the key relationships between the economy and the environment and the varying importance attached to these relationships by the environmental economics profession.

### Section Learning Outcomes

By the end of this section, students should:

- understand the complexity of the interaction of economy and environment
- understand the extent to which economic activity can use the environment before resource sustainability becomes an issue

### 1.1 Defining economics and the environment

Our starting point is to place this module within the field of environmental economics. To do this, we need first to have an idea of what we mean by economics and the environment.

A dictionary definition of economics would be something like:

*the science of the management of the material resources of an individual, community, or country.*

Thus, economics is about the allocation of scarce resources amongst competing uses.

What about 'environment'? A broad definition of the environment might be the surroundings: the conditions influencing development or growth. Thus, you might include any number of things that are around you as being part of our environment. For example, the environment can be defined to include all flora and fauna, aquatic ecosystems, energy and material resources, and the atmosphere (Hanley *et al* 2007).

There are many examples of the way in which the economy and the environment interact and are interdependent (eg agriculture and the environment). Society has become very aware of the environmental impact of agriculture over the last few decades because of the increased understanding of the negative consequences of certain agricultural practices. At the same time it has become apparent that many of these practises have resulted from the policies introduced to encourage farmers to produce agricultural output. Examples of the negative consequences of agriculture include water pollution (both surface and groundwater), soil erosion and soil

compaction, the loss of wetlands because of drainage, and the loss of biodiversity because of land clearance for more agriculture as well as the adoption of new technologies. These outcomes have resulted because many commodity-specific price and income support programs, such as those in the EU, North America, and Australia, did not require farmers to take account of the environmental consequences of their actions.

## 1.2 Links between the economy and the environment

Let us begin by considering in general the ways in which the economy and the environment are interlinked. Then we will look at how environmental economics has developed and the scope of the subject. We employ the typical characterisation found in many textbooks and assume that the economy can be divided into two sectors: production and consumption. These sectors use the environment in three main ways.

- as a supplier of natural resource inputs
- as a supplier of environmental or amenity goods
- in its capacity as waste sink

Using the environment in one of these ways may affect the other uses, as will become clear in the following discussion.

### Supplier of resource inputs

Land, water, and stocks of raw materials are important inputs to production. These resources frequently vary between countries and so will affect the country's economy. Some countries will have large stocks of minerals, while others have good arable land.

Natural resources are either renewable (eg trees) or non-renewable (eg crude oil). This distinction is important as it influences the way the resources have to be managed in production.

These resources are used by the production sector to create goods and services for use by consumers, or as inputs for another part of the production sector, but in the process waste products will also be produced.

**?** Can you think of an example from your country where a natural resource is used in a production process, resulting in both a product for use by consumers and a waste product?

Answer

*An example could be coal used to generate electricity. As the coal is burned, it produces electricity, but at the same time, carbon dioxide and sulphur dioxide are also produced, and these may have detrimental effects on the environment.*

### Supplier of environmental or amenity goods

Economic benefits (ie increased utility) may be directly derived from the consumption of the flow of services that are forthcoming from a stock of environmental goods. There are many examples of where the environment provides amenity benefits for society. For example, some countries enjoy beautiful landscapes and the public benefit from these via their associated recreational services and tourism.

Environmental stocks of trees can offer global services such as climatic regulation because the trees absorb carbon dioxide, which might otherwise contribute to climate change.

Many people get enjoyment from the biodiversity that exists in the world, and this can also be considered as a form of public consumption of an environmental good.

### Waste sink capacity

This is the capacity of the environment to assimilate the waste products of production and consumption and convert them into harmless or ecologically useful products. This use of the environment is the one we are most concerned with in this module, as we look at the introduction of policies which affect how, and at what level, the environment is used as a waste sink.

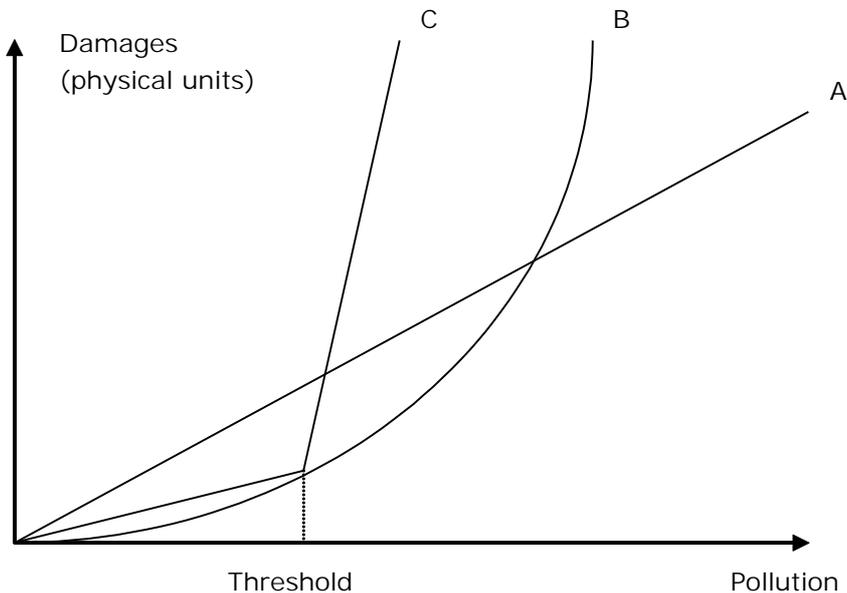
The environment is not only affected by waste products but also by intentional releases of chemicals, such as pesticides, wood preservatives, paints, and lubricants. Let us put some figures on to these wastes and intentional releases.

The impact of human activity on the composition of chemicals in the atmosphere is clear. Since 1750, pre-industrial period, carbon dioxide concentrations have changed from 280 parts per million in 1750 to 380 parts per million in 2000. There have also been significant increases in other gases such as methane and nitrous oxide. There are serious concerns being expressed about these increasing concentrations in the atmosphere and climate change (Stern 2007).

We are thinking here about the physical assimilative capacity of the environment. This is the physical capacity of the land, water and the atmosphere to absorb wastes and is determined by physical factors such as the climate, rainfall, wind patterns, and geographical location.

When thinking about waste we need to distinguish between degradable and cumulative pollutants. With cumulative pollutants we need to understand if there are any important thresholds that need to be avoided. The figure in 1.2.1, below, illustrates the importance of assimilative capacity for threshold and non-threshold cumulative pollutants.

## 1.2.1 Pollution damage functions



Source: adapted from Hanley et al (2007) p. 4

In 1.2.1 we have drawn three damage functions. Function A shows a simple linear damage function, Function B an exponential damage function, and Function C a damage function with a threshold. The important issue captured by Function C is that there is point beyond which a pollutant has a significantly increased impact on the environment. An example is the level of oxygen in water which, if it falls below a particular level, becomes extremely dangerous for fish.

It is common practice to describe the assimilative waste capacity of the environment mathematically.

Stock of degradable pollutant ( $S_t^a$ ) at time  $t$  is given by

$$S_t^a = F_t - A_t$$

Stock of cumulative pollutant ( $S_t^c$ ) at time  $t^*$  is given by

$$S_t^c = \sum_{t_i}^{t=t^*} F_{t_i}$$

where

$F_t$  is the positive flow in a year

$A_t$  is the amount assimilated in a year

$t_i$  is the starting date for emissions

$\Sigma$  is the sum of the item specified for the time periods given, in this case from the start,  $t_i$ , to time  $t^*$ .

Environmental management can require that we take actions to prevent further pollution because we think that an important threshold might be breached. The term used to describe this type of environmental management is the precautionary principle.

The precautionary principle states that action on preventing or restricting environmental damage should not be delayed just because there are uncertainties about how the damage is caused or the level of damage (Hanley *et al* 2007 p. 11).

### 1.3 The first two laws of thermodynamics

The natural laws which govern the environment and which are, therefore, of interest to us are the first two laws of thermodynamics. These relate to closed systems. Strictly speaking, the earth is not a closed system as it receives energy from the sun, but it is almost a closed system.

#### First law of thermodynamics

The first law states that whenever energy is converted in form, its total quantity remains unchanged. In other words, energy (or matter) can be neither created nor destroyed.

Common and Stagl (2005) use the example of coal-fired electricity generating plant. The coal is heated which produces electricity. A by-product of this process is waste heat that is transported away as cooling water or gases. In addition, various waste gases are emitted into the atmosphere, which cause pollution, such as acid rain.

#### Second law of thermodynamics

This law states that in a closed system, entropy does not decrease.

Entropy could be described as a measure of the 'disorderedness' of energy. For instance, ordered energy is useful and an example of this is the energy stored in a battery. However, disordered energy is not useful, and an example is the energy dispersed into the environment by a fire.

Entropy is a thermodynamic property of matter and is related to the amount of energy that can be transferred from one system to another in the form of work. For a given system with a fixed amount of energy, the value of the entropy ranges from zero to a maximum. If the entropy is at its maximum, then the amount of work that can be transferred is equal to zero, and if the entropy is at zero, then the amount of work that can be transferred is equal to the energy of the system.

During an irreversible process the entropy of a system always increases.

The key points to remember from the above are that, because of these natural laws:

- increased extraction of minerals by the production process leads to an increase in wastes
- there is a limit on the substitutability of inputs
- since production and consumption lead to the dissipation of matter, scarce energy is needed for recycling

The importance of these two laws relates to the use, re-use, and recycling of the environment after interactions with the economy.

Let us look more closely at the subject of recycling, as this would seem to offer a chance for the economy to retain the use of scarce resources.

## Recycling

There is a hierarchy of resource use that includes recycling. This is referred to as the 3R's – reduce, re-use, and recycle. The final and least appealing option after resource use is to dispose of any remaining waste.

There are now many materials which are routinely recycled and re-used. For example, glass bottles have been collected and re-used by a number of drinks companies for many years. In various countries this practice is encouraged by the use of deposit-refund schemes. Other examples include paper, metal, glass, plastic, textiles, and garden waste.

For instance, in the Netherlands, household waste that can be composted is collected separately from other household waste and is composted by the local authorities. To encourage citizens to participate in this scheme, householders received some free compost soon after the scheme was set up. However, there are clearly costs involved in such a scheme.

- separate waste bins were provided for the compostable waste
- information was provided to householders
- householders use time to separate their waste
- costs of separate collection and of dealing with the compost

In the Netherlands, chemical household waste is also collected separately, with similar costs involved. There are numerous examples of different economic instruments used to deal with waste at both the household level and industry.

There are clearly limits to what resources can be re-used and recycled. These limits are not only dictated by the laws of thermodynamics but also the costs associated with re-using and recycling many items.

## Section 1 Self Assessment Questions

### Question 1

List the four main components of the environment.

### Question 2

What are the three ways in which society uses the environment?

### Question 3

True or false?

- (a) According to the first law of thermodynamics, energy can be destroyed.
- (b) The 3R's of resource use are reduce, re-use, and recycle.

## 2.0 ORIGINS AND SCOPE OF ENVIRONMENTAL ECONOMICS

### Section Overview

In this section we provide an overview of the discipline of environmental economics and current philosophical schools of thought. This in turn provides a useful means by which to understand the scope of the discipline.

### Section Learning Outcomes

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

- understand the relationship of environmental economics to economics in general
- appreciate the differing importance that environmental economists attach to the physical constraints imposed by the environment on economic activity

### 2.1 Origins of environmental economics

Environmental economics developed in its present form in the 1960s as a result of the intensification of pollution and the heightened awareness among the general public in Western countries about the environment and its importance to our existence.

Economists became aware that, for economic growth to be indefinitely sustainable, the economic system needs to take into account the uses of the environment that we have already mentioned, so that natural resources are not depleted and so that the environment is not overused as a waste sink. Environmental economists view the environment as a form of natural capital which performs life support, amenity, and other functions that cannot be supplied by man-made capital. This stock of natural capital includes natural resources plus ecological systems, land, biodiversity, and other attributes.

The growth of environmental economics in the 1970s was initially within the neo-classical paradigm. In general, this approach to the environment is concerned with issues of market failure, inappropriate resource allocation, and how to manage public goods. There was little concern for the underlying relationships between the economy and the environment. Concerns about the limits of this approach to environmental economics led some environmental economists to develop what is now referred to as ecological economics.

Ecological economics views the relationship of the economy and the environment as central. Thus, any analysis places economic activity within the environment. This distinction is best illustrated with reference to debates concerning sustainable development and the difference between weak and strong sustainability. Ecological economics supports the notion of strong sustainability. This view of sustainability assumes that not all forms of capital (ie human and natural) are perfectly substitutable.

At times, the distinction between neo-classical environmental economists and ecological economists is of no practical relevance. However, the underlying philosophical differences do matter in certain contexts, and the main environmental economics journals illustrate this. In particular, the journal *Ecological Economics* publishes many papers that support this view of the world.

In the context of this module the material presented is generally accepted by both neo-classical environmental economists and ecological economists. The differences between the approaches are more obvious and important when we examine issues of resource management and sustainable development.

## 2.2 Scope of the discipline

We have now discussed to some extent the place of environmental economics as an academic discipline and how it has developed. We are now in a position to examine the role of environmental economists in policy design and implementation.

Essentially, environmental economics revolves around three broad questions.

- What are the economic and institutional causes of environmental problems? That is, how do the economic and social systems shape incentives in ways that lead to environmental degradation as well as to improvements?
- How can we assess the economic importance (ie monetary value) of environmental degradation/improvements?
- How can we design economic incentives to slow or halt environmental degradation and bring about improvements in the quality of the natural environment?

The first question leads to an analysis of market failure and government failure.

For example, one of the principal reasons for market failure is that there are incomplete markets for environmental assets. By incomplete we mean there are many cases where no market exists for the efficient allocation of an environmental resource. There are plenty of examples of where markets are incomplete including:

- clean air
- beautiful views
- unpolluted beaches
- tropical rainforests, with their biodiversity and their carbon-fixing properties
- a quiet environment

To ensure that we employ scarce resources efficiently the environment needs to be included in economic calculations, and environmental economics aims to do this.

The second question requires that we are able to place economic values on environmental degradation/improvements. As we have already noted, many environmental resources and goods are not priced in markets. Thus, to do this, environmental economics has developed a set of methods to place values on these types of goods.

To address the third question we will use economic tools to critically evaluate environmental policies and whether they are likely to achieve the aims of decreasing or halting environmental degradation.

## Section 2 Self Assessment Question

### Question 4

True or false?

- (a) Environmental economics is a development of the neo-classical paradigm.
- (b) Ecological economics proposes that the stock of natural capital available may impose limits to economic growth.
- (c) A key objective of environmental economics is to ensure that the design and implementation of environmental policy reduces degradation to efficient levels.

## 3.0 BASIC ECONOMIC PRINCIPLES

### Section Overview

In this section we introduce and develop the most important economic concepts in relation to environmental economics. Given the focus of the subject area we concentrate on microeconomic principles. In this section we provide a brief introduction to some of the economic terminology that you will come across as you work your way through this module. Pay particular attention to the words and phrases that are highlighted. Don't worry if their meaning is not entirely clear at this stage. We will be returning to look in detail at many of the underlying concepts later in the module.

### Section Learning Outcomes

By the end of this section, students should:

- understand the link between economic principles and environmental issues
- understand the ways in which the key concepts employed by economists are use in applied policy analysis

### 3.1 Positive and normative economics

Economists frequently distinguish between 'positive' and 'normative' economics. Positive economics is concerned with the development and testing of positive statements about the world that are objective and verifiable. Normative statements derive from an opinion or a point of view. Thus the words 'should', 'ought to' or 'it is better to' frequently occur. The validity of normative statements can never be tested. Positive statements, on the other hand, can be tested, at least in theory, if not always in practice.

For anyone working in a management position it is helpful to distinguish between positive and normative statements. Managers and the people they work with, or are advised by, are likely to make liberal use of both, although normative statements may sometimes be disguised as positive statements. Whilst both types of statement may deserve attention, better management decisions are likely to result when the distinction between them is recognised.

It is often possible to rephrase normative statements in such a way that they become positive ones. For example, the normative statement 'the subsidies of the European Union's Common Agricultural Policy (CAP) should be removed' could be rephrased as the positive statement 'removing CAP subsidies will raise farm prices in developing countries'. The validity of the latter statement could, in theory, be tested.

Whether or not raising farm prices in developing countries is a good thing is another question. To say that 'raising farm prices in developing countries is a good thing' is a normative statement. On the other hand, the assertion that 'raising farm prices in developing countries will improve rural incomes in those countries' is a positive statement. Why? Because, again, it could, in theory, be tested. It does not say that rural incomes in developing countries ought to be raised, just that higher farm prices will have that effect.

To say that rural incomes should be raised is a normative statement, which you may well agree with, especially if you live and work in the rural areas of a developing country, or believe that increasing rural incomes is the best way to reduce poverty. On the other hand, if you live in the city of a developing country and believe that the removal of CAP subsidies will raise food prices, or if you are an EU food producer dependent upon CAP subsidies, you may feel differently about this – you may be less keen on raising rural incomes in developing countries, unless other ways can be found of achieving it.

You will notice that positive statements can often be broken down into a cause and an effect. Whether the effect is desirable or not is a normative question that will depend upon the subjective opinion of those affected. Economists practising positive economics can help analyse the effects in greater detail by breaking them down into positive and testable statements in the way we have done above. They can advise policy-makers in government, business, and other organisations both on the effects of specific policies and on the specific policies that need to be implemented in order to achieve desired effects. However, it is ultimately politicians and managers, and the people that empower them, that decide – on the basis of normative judgements – what is ‘desirable’ and what is not.

It is important to realise that economists practising positive economics do, however, make value judgements. Any analysis involves an element of subjectivity. In the first place, even what to analyse and how to analyse it often depends upon the subjective views of the analyst regarding what is, and what is not, important. Economic decisions have many different effects and it is rarely possible to examine them all in detail.

Indeed, whether to examine a problem from an economic perspective at all, or whether to focus instead on alternative perspectives, such as those provided by the disciplines of sociology, biology, or political science, depends in large part on normative/subjective views of the world.

### 3.2 Applying scientific methods and reasoning

Scientific reasoning involves constructing theories to explain how the world works. In general, the simplest explanation is preferred. As new information about the world becomes available which throws doubt on a theory, then the theory is modified. Consider the following example of how the process can be applied to an economic problem.

- We have the following information about the world – supermarkets are selling more organic apples than before – and we want to know why this is the case.
- Now we construct a theory – the volume of organic apple sales depends upon the price at which they are sold – this is a positive statement.
- Next we state a hypothesis – the volume of organic apples that a supermarket will sell rises if it reduces the price of organic apples – another positive statement.
- Then we test it by looking for evidence to support the price-sales link in different countries and for different time periods.

- If the evidence supports the hypothesis
  - we accept it, and
  - move on to more refined hypotheses, such as those relating to how big the response by consumers is to price changes.
- If the evidence does not support the hypothesis, we either
  - modify the hypothesis, or
  - reject it.

This process of trial and error gradually leads to a theory that fits well with experience. It enables the economist to

- explain what has happened
- say what might happen in the future when prices change

Can the theory be tested?

In the organic apple sales example, yes.

But what happens if the hypothesis is not testable?

You have to try to frame ideas of how the world works in such a way that evidence can be found to support or reject the idea. Incidentally, this limits what we can theorise about. In practice it is sometimes possible to find a way round the unmeasurable by using a proxy variable. This is a variable that reflects the characteristics of the other, unmeasurable, one. So in the case of placing a monetary measure on the value of the environment we can

- look at the price paid for related goods
- ask individuals using survey methods what value they place on the environment

This is not perfect, but proxy variables can be a way round such problems.

Why do economists make assumptions?

In everyday life assumptions are made because nothing would ever be achieved without them. Whenever we open an economics textbook we do so with the underlying assumption that, for whatever reason, economics is a subject worth studying. We don't examine this assumption in detail every time we open an economics book (unless we are extremely disillusioned) because otherwise we would make very little progress with our reading. We also learn from experience which assumptions have lasting validity.

This illustrates an important reason why economists make assumptions. Assumptions save time and concentrate the mind on the problem to hand, and when well-proven become part of the body of established knowledge.

The use of assumptions in economics also relates to the need for an analytical method that provides clarity, scientific rigour, and flexibility.

Consider the theory represented by the positive statement that we made earlier: 'the volume of organic apples that a supermarket will sell rises if it reduces the price of organic apples'. The theory is stated with the assumptions that: (a) the quality of

apples remains constant; (b) consumers are made aware of the price fall; and (c) consumers prefer more apples to fewer apples.

The use of these assumptions helps clarify the relationship between organic apple sales and organic apple prices. It does so in a scientific manner by explicitly recognising that organic apple sales can also be affected by other variables such as quality, price information, and consumer preferences. In a controlled laboratory experiment these variables would be kept constant. In economics it is not possible to conduct laboratory experiments. Instead, economics depends greatly on the techniques of statistics for testing its theories and hypotheses. These techniques can be used to identify the relationship between different variables, such as sales and price.

Setting out underlying assumptions when developing and testing a theory or hypothesis also provides the analyst with the flexibility to vary the assumptions at a later date. Modifying assumptions and examining the effects of these modifications on the original theory provides a methodical way of examining economic problems and the variables that link cause and effect. For example, once we have established the nature of the link between apple prices and apple sales we can move on to look at the link between sales and quality.

What is an economic paradigm?

It has been observed that research tends to cluster around 'big ideas' called research paradigms. Once a particular paradigm is accepted as dominant, people often research issues adopting these central tenets. In the 1950s and 1960s the dominant economic paradigm regarded markets as being prone to failure, and the duty of government was to intervene and correct these failures in an impartial manner. People became disenchanted with this approach as a result of the 1967–1977 decade of inflation and unemployment, leading to the ascendancy of a new paradigm – one which regarded government intervention as being more likely to worsen than improve market failures. In this paradigm, the job of government is limited to the role of ensuring free competition and making companies respond to shareholders. In recent years, this paradigm has begun to be displaced by one that re-emphasises the role of government in correcting market failures. This is especially the case in environmental economics, although the 'credit-crunch' of 2008 drew attention to problems in financial markets that were possibly under regulated.

### 3.3 Terminology and basic concepts

Like any academic discipline, economics abounds with terminology and jargon. Sometimes it may seem as if the terminology of economics is designed to confuse. However, its purpose, when used properly, is to convey in a concise and precise manner the meaning associated with certain basic concepts and to facilitate the discussion of economic problems. Of course it can, like so many useful innovations, be abused. It can be used to mystify rather than clarify, and to take shortcuts that create ambiguity at the expense of precision. You should always be on your guard against such abuses.

## Economic agents

Business and development managers need to know about the economic agents they will be working with, competing against, representing, or producing for. Economic agents are individuals, consumers, managers, business owners, shareholders, or workers. In fact, an economic agent is anyone who acts in an economic way, allocating resources to satisfy wants.

The firm may also be treated as a unitary economic agent with the sole objective of maximising its profits (defined as the surplus of revenue over costs). This is, of course, a simplification of how real firms work, since, in practice, they usually consist of a number of different agents, such as managers, workers, and shareholders, each with their own set of objectives. Nevertheless, it is a useful assumption to make when examining the choices that confront the managers of a business enterprise.

## Markets

The definitions of a market are varied and often depend upon the context in which the word is used. A market or market place is often identified with a specific location where goods are sold or exchanged. Today, the exchange of goods and services does not always take place at a specific location. A more appropriate definition of a market might be 'a mechanism by which buyers and sellers of goods and commodities are brought together for the purposes of exchange'. The market might involve buyers and sellers haggling over the price of goods displayed in stalls on the village square, or it might be on the internet whereby computer users from all round the world can view, order, and pay for products online.

A market may also involve a combination of different exchange mechanisms. Economists talk in terms of the market for a particular good or service, such as the market for apples, for books, or financial services. Various mechanisms may be used for selling in each of these specific markets.

## Efficiency

Efficiency is a word that is often thrown about without much thought being given to its precise definition. Doing something efficiently is often the economists' or managers' way of saying that it is done well, as opposed to badly or inefficiently. As such it is usually something to be strived for. In fact there are various different forms of efficiency, each with their own specific definition. For now we can assume that efficiency is associated with activities that tend in some way or other to maximise benefits and minimise costs.

Many economic concepts and their associated terminology are linked in one way or another to the goal of achieving economically efficient outcomes. They include those listed below.

- Opportunity cost: economically efficient outcomes are only possible when one takes into account the opportunity cost of an action or resource. In taking a particular course of action or utilising a resource in a particular way, one is forgoing the opportunity to undertake an alternative course of action or utilise the resource in a different way. Opportunity cost, therefore, equates to the benefits forgone in the next best alternative use or action. For example, the economic cost of chopping down a forest is not just the cost of employing labour and machinery to do the job, but also includes the cost of lost opportunities to use the forest for alternative purposes, such as for recreation, or to provide environmental benefits.
- Productivity: productivity is usually used in relation to labour, but can be measured in terms of the output per unit of any factor of production, such as land, labour, capital, water, and so on. A plantation may, for example, substitute agricultural machinery for labour. The few labourers that are left each produce far more than they did before the machinery was introduced. However, the machinery may break down frequently, disrupting production and reducing per hectare yields. Whilst labour productivity has increased, land productivity may have fallen.
- Marginal analysis: in studying economics you will soon become familiar with the concept of marginal analysis. Economists are interested in the cost or benefit associated with the consumption or production of the next additional unit. For example, if we extract another litre of oil from the ground will the cost of extraction be more or less than the benefit obtained. If the benefit is greater than the cost we would proceed.

## Section 3 Self Assessment Questions

### Question 5

The opportunity cost of an input in a production process is best defined as:

- (a) the cost of the input in units of money
- (b) the price set by the government
- (c) the price usually paid in actual markets
- (d) the value of commodities that could have been produced in the best alternative use of the input
- (e) none of the above

### Question 6

Explain the difference between positive and normative economics.

### Question 7

Write three short examples each of positive and normative economic statements.

## 4.0 THE NEO-CLASSICAL ECONOMIC MODEL

### Section Overview

In this section, we introduce the neo-classical model and its underlying assumptions. Most of the basic theories developed in neo-classical economics begin with the model of perfect competition. The assumptions upon which this model is based are usually taken as a starting point. Economists know that we do not pretend to live in a world of perfect competition. However, the assumption of perfect competition allows us to identify important aspects of economic behaviour as well as the economic outcome of such behaviour. It helps reveal key economic relationships that might otherwise remain obscure. Once we understand what occurs under perfect competition we can begin to relax some of the model's assumptions and observe the effects.

### Section Learning Outcomes

By the end of this section, students should understand:

- the key assumptions that underpin basic economic models and analysis
- key assumptions that are required for the basic model to work
- the relationship between supply and demand
- the importance of measures of elasticity in conducting economic analysis of market behaviour

### 4.1 Perfect competition

The main focus of the neo-classical model is on the question of how resources can be allocated most efficiently. It promotes the development of freely competitive markets in which individuals are given as much economic freedom as possible; the individual is left to decide what to buy, what to produce, and what to sell.

Ideally, the market should resemble as closely as possible the model of perfect competition. Theory can show that a perfectly competitive market can result in the most efficient allocation of resources. From the narrow viewpoint of economic theory this can be termed the optimal result for society, or the socially optimal outcome. This theoretical result applies both to a single market and to all the markets in an economy if all could be perfectly competitive. Thus, if markets work badly, according to this theoretical model the government has a duty to individuals and to society to correct this, ie governments should intervene to correct market failure.

So what is perfect competition?

The model of perfect competition rests on a number of key assumptions.

- Rationality

The first assumption made is that people are economically rational, preferring more of those goods and services they value to less.

Does this sound reasonable? The answer is surely, yes.

It is a short step from wanting more rather than less of the good things to wanting to maximise the amount of good things (literally 'goods') you can get. Rational economic man or woman has objectives, and attempts to maximise them. In neo-classical economics, this is stated as follows:

- consumers allocate their incomes in order to maximise their satisfaction from the goods and services they consume
- producers allocate resources in order to maximise their profits

Does this still sound reasonable? It is at this stage that doubt may creep in, especially with regard to profit maximisation. After all, business decisions are taken by managers, who are frequently not the owners of the business.

Nevertheless, the profit maximisation assumption is still plausible, if not inevitable. If managers create more value at lower cost than competitors, their business will prosper, its profits will rise and managers may be rewarded accordingly. And even if the profit maximisation motive isn't always valid it is still useful to consider the outcomes that would arise if it were.

- Perfect knowledge

More contentious is the second assumption of the neo-classical model: that economic agents make decisions in the light of perfect knowledge. Buyers and sellers know all the prices of all the goods in the market, know everything they need to know about the quality of goods, the character of the other economic agents, what the government is going to do next, and so on. There is no doubt, no uncertainty. Like a computer with perfect knowledge, rational economic man can compare prices with what they have or want, and set out to maximise their objective, be it consumer satisfaction or business profits.

In reality this is frequently an unrealistic assumption. So in practice economists will start by examining the world as if perfect knowledge existed and then they relax this assumption so as to make their analysis more realistic. In this way, we use the neo-classical model as the basis for a comparison with the real world. The same applies to the remainder of the assumptions presented here.

- Many participants

A perfectly competitive market consists of a large number of participants who are 'price-takers'. That means that an individual participant has no influence on market prices – they must accept the market price for whatever they buy or sell. If the market were dominated by a few participants, individual participants would not be price-takers and the market would not be perfectly competitive. At the opposite end of the spectrum to perfect competition is monopoly where the monopolist determines what the market price will be.

- No barriers to market entry or exit

If a market is to be truly competitive, there must be scope for new buyers and sellers to enter a market, and for old participants to leave and find other markets. This of course applies to markets for resources like labour as well as markets for goods and services. If the wages of plumbers are high compared to the wages of carpenters, the latter will leave their jobs and look for jobs as plumbers. We speak of 'resource mobility' in this respect.

- Homogeneous commodities

This assumption requires that the good or service associated with a particular market is identical in all respects. For example, in the apple market all apples are assumed to be of equal size, shape, colour, taste, origin etc. In other words there is nothing to distinguish one apple in the market from another. As with rationality in much applied analysis this assumption is relaxed. Indeed, product differentiation is an important business strategy, as can be seen on the shelves in shops or supermarkets throughout the world – in reality an apple is not just an apple, but can be small, large, have a flavour that is sharp or sweet, the colour may be yellow, green, red, and so on.

## 4.2 Methods of economic analysis

Economics uses three ways of describing theories. Two are mathematical: algebra, and graphs or diagrams; the third is simply in words, through progressive logical explanations.

We use words every day, so many people find that introductory economics is most accessible when presented in narrative form. The trouble is that words can be ambiguous, vague, and long-winded!

Diagrams are useful because they allow you to picture a relationship. From a diagram it is possible to capture at a single glance something that may take several paragraphs of text to describe in words. The most commonly used diagram in economics is the one that depicts supply and demand, an upward sloping line/curve (supply) intersecting with a downward sloping line/curve (demand) in the shape of an x. We shall be examining this diagram in the next unit.

Algebra is the most concise way of describing economic theories, and much of economics can be expressed in a few pages using calculus. The models developed in this way can capture static or dynamic relationships as well as being partial or general equilibrium analysis.

- Often we compare one equilibrium position in a market with another equilibrium position in the same market, a procedure called comparative static analysis. (An equilibrium position occurs where supply is equal to demand and the price is stable.) The alternative to static analysis is dynamic analysis. This concentrates on the behaviour of models out of equilibrium, typically moving from one equilibrium to another.
- A general equilibrium analysis tries to consider all the markets and all the forces that affect the subject under examination. Partial equilibrium analysis assumes that other things remain the same beyond the boundaries of the market or area that is our concern. This works quite well for small changes, but becomes an inaccurate method when large important changes are considered.

### 4.3 Demand

We now examine the basic features of how markets work. We look at the role played by consumers in the market, and the business opportunities that markets create. Markets work via interactions between supply and demand (which are represented graphically by the supply curve and the demand curve). Understanding the nature of these interactions is essential for the tasks faced by managers in both business and development.

Some key aspects of the theory of consumer demand are as follows:

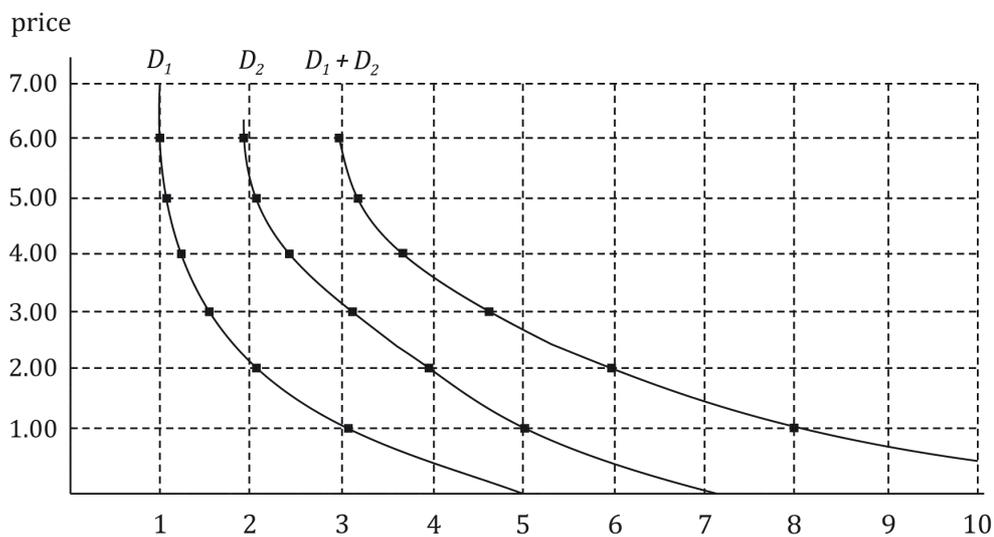
- The *ceteris paribus* assumption. It is an important and commonly used assumption in economics. When examining the relationship between price and demand we have to assume all other influences on demand remain constant or unchanged. Of course, if other factors are not held constant then a fall in price may not be enough to increase demand, such as in the case where consumer incomes are dropping at the same time as prices are dropping. Nevertheless, even in such a case, the expected inverse relationship between price and demand implies that the depressed demand caused by a decline in incomes will, in part at least, be offset by the rise in demand resulting from the price fall.
- The distinction between movements along the demand curve and shifts in the demand curve. Movements along the demand curve result from a change in the price of the good being demanded (*ceteris paribus*). A shift in the demand curve is caused by other factors, such as changes in consumer incomes or tastes, or in the price of other goods.
- A demand curve may in fact be a straight line. The shape of the demand curve is determined by consumer tastes and preferences.
- A demand curve can be used to represent the demand of an individual consumer, a group of consumers, a nation of consumers or, indeed, a whole world of consumers. In the table in 4.3.1 and figure in 4.3.2, below, you can see that a market demand curve is derived by summing the demand of individual consumers at each price. In this case there are only two consumers, with demand curves  $D_1$  and  $D_2$ . The market demand curve is thus  $D_1 + D_2$ .
- Demand is synonymous with consumption or purchase, not want. If the annual demand for apples is five tonnes at a given price, then that is what is actually purchased at that price. The amount of apples people aspire to consume is sometimes referred to as real demand and the amount they do consume as effective demand. When we talk about demand we are referring to effective demand unless we state otherwise.

### 4.3.1 The demand schedule for apples

Price (£)	$D_1$ demand (kg)	$D_2$ demand (kg)	Market demand (kg) $D_1 + D_2$
1.00	3.0	5.0	8.0
2.00	2.0	4.0	6.0
3.00	1.4	3.3	4.7
4.00	1.1	2.6	3.7
5.00	1.1	2.0	3.1
6.00	1.0	2.0	3.0

Source: unit author

### 4.3.2 Summing demand curves



Source: unit author

### Substitutes and complements

The question of whether goods are substitutes or complements is an important one that can be very helpful in analysing the demand for various goods and services. For example, if we want to understand fluctuations in the demand for sugar we may

gain insights by looking at the demand for coffee because the two products are complements. For example, if there is a sudden fall in the demand for sugar, people in the industry will want to know why. In this hypothetical case the answer is found by looking at the demand curve for coffee. The price of coffee has risen suddenly, causing a contraction in demand (an upward movement along the coffee demand curve). Since many people use sugar in their coffee, changes in the coffee market have a significant effect on the sugar market also. The two goods are complements, so a rise in the price of coffee results in a fall in the demand for both sugar (the demand curve for sugar shifts to the left) and coffee (movement along the demand curve).

Let's now look at an example of substitutes. From an environmental perspective it is beneficial for consumers to switch consumption from environmentally damaging products to close substitutes that are less harmful to the environment. Government taxation policy, as in the case of the unleaded fuel example, is considered by many economists to be an appropriate way of encouraging such a change. However, such a policy will often only work effectively if there are reasonably close substitutes for the goods that are being discouraged. For example, attempts to reduce the use of private cars by raising the cost of driving (through road taxes, tolls, price of fuel etc) will only have a limited effect if consumers do not consider alternative forms of transport (typically public transport) to be a close enough substitute for private cars.

## Elasticity

Elasticity, as the name suggests, is a measure of responsiveness. When we talk about demand elasticity (which in economics we often do) we are referring to the responsiveness of demand to particular factors that have an influence on demand. The resulting elasticities of interest include the following:

- (Own) price elasticity of demand. If the price elasticity of demand for a particular good is high then a change in the price of that good will have a very significant effect on the demand for that good. If, on the other hand, the elasticity is low, even fairly large price changes will fail to have a significant impact on demand. Another way of saying 'high elasticity' is 'very elastic', or 'inelastic' in the case of low elasticity.
- Income elasticity of demand. As we have seen, income can have a significant influence on the demand for a particular good or service. A good whose demand is highly elastic with respect to income will be consumed in much greater quantities if incomes rise or much smaller quantities if incomes fall.
- Cross-price elasticity of demand. We talk about the cross-price elasticity of demand of good A with respect to good B. This is a measure of the influence of good B's price on the demand for good A.

Given these definitions of elasticities the following points can be observed:

- An elasticity of zero implies that the factor under consideration has no influence on demand.
- An elasticity between zero and 1 represents a positive influence on demand, but one that is said to be inelastic. The percentage change in demand is less than the percentage change in the influential factor.

- An elasticity greater than 1 signifies an elastic relationship. The percentage change in demand is greater than the percentage change in the influential factor.
- Own-price elasticities of demand are usually negative, reflecting the inverse relationship between price and demand; however, the negative sign is typically ignored.

A perfectly inelastic demand curve is depicted by a straight vertical demand curve. The amount consumers demand is fixed and unaffected by price. Few commodities are perfectly inelastic, but quite a number may approach it, for example, water, food, and fuel.

A summary of formulae to estimate demand elasticities is presented in 4.3.3.

#### 4.3.3 Summary of formulae to estimate demand elasticities

- (1) (Own) price elasticity is a measure of the influence on demand of variations in the good's own price. It is given by the following equation

$$\text{price elasticity of demand} = \frac{\text{percentage change in demand}}{\text{percentage change in price}}$$

- (2) Income elasticity is a measure of the influence on demand of variations in consumer income

$$\text{income elasticity of demand} = \frac{\text{percentage change in demand}}{\text{percentage change in income}}$$

- (3) Cross-price elasticity is a measure of the influence on demand for good A of variations in the price of another good, B

$$\text{cross-price elasticity} = \frac{\text{percentage change in demand for A}}{\text{percentage change in price of B}}$$

Source: unit author

It is important to bear in mind that the responsiveness of demand to price changes will depend on the current level of consumption/demand. Consider the following example from the water sector. When the price of water is so low as to be almost insignificant, and large volumes of it are being consumed (ie at the bottom of the demand curve), a doubling of the price of water (assuming it is metered) may have little or no effect on consumption. Under these circumstances, demand for water with respect to price is perfectly inelastic, or almost so. However, as one moves back up the demand curve, demand will probably respond more to price changes. As the price of water gets higher, consumers will pay more attention to the cost of using water. In other words, elasticity will increase, at least initially. The elasticity at any particular price level will depend upon the shape and position of the demand curve.

Elasticity is a useful concept for helping us to understand the way markets work, particularly markets in the food, agriculture, and natural resources sectors.

#### Normal goods and inferior goods

A normal good is one for which demand increases as income increases.

Goods that are not normal are called inferior goods. In other words, as income

raises demand for these goods falls.

## 4.4 Supply

Now that we have introduced the demand schedule and taken a look at the factors that influence demand, we turn our attention briefly to supply.

It is sufficient to understand that, providing one accepts the profit maximising assumption, firms/suppliers will, *ceteris paribus*

- raise output if prices rise or costs fall
- reduce output if prices fall or costs increase

Movements along the supply curve result from a change in the price of the good being supplied (*ceteris paribus*).

A shift in the supply curve is caused by factors that affect the cost of production, or any other factor affecting the volume of production other than the price of the good itself. Examples are the impact on harvests of the weather or outbreaks of pests and diseases. Changes in technology may also shift the supply curve by changing the cost of production per unit of output.

### Elasticity of supply

The elasticity of supply is a measure of the responsiveness of supply to some influence. Here, we are only concerned with the elasticity of supply with respect to price, that is, the responsiveness of supply to variations in the price of the good being supplied. The own price elasticity of supply is defined by the following formula:

$$\text{price elasticity of supply} = \frac{\text{percentage change in supply}}{\text{percentage change in price}}$$

The same general principles apply as in the case of demand elasticities. Perfectly inelastic supply curves are straight vertical lines with an elasticity of zero. Elasticities between 0 and 1 represent inelastic supply response, whilst those greater than 1 signify an elastic supply response. It is also important to note that there can be differences in the position of supply curves in short and long run. Long-term supply curves tend to be much more elastic than short-term supply curves. This is because, in many contexts, supply cannot be adjusted in the short run because of physical as well as financial constraints on the firm. Given a long enough period, almost any adjustments to the production process can be made.

## 4.5 Supply and demand – finding the market equilibrium

We now examine how an industry supply curve and market demand curve interact to produce a market equilibrium. We have already discussed the factors that affect the shape and position of each of these curves: price, income, and consumer preferences in the case of the demand curve; price, costs, and other factors in the case of the supply curve.

- It is important to bear in mind that the supply curve and the demand curve are both independent of each other. The shape and position of the demand curve is

not affected by the shape and position of the supply curve, and vice versa.

What the supply and the demand curves have in common is their representation of responses to price.

In a perfectly competitive market an equilibrium is achieved when supply equates to demand.

$$Q_S = Q_D$$

Thus, price varies until  $Q_S = Q_D$ . Two key mechanisms are involved in ensuring that if price is not at this clearing level, it will adjust until it reaches that level. These are as follows.

- If the price lies above the clearing price, producers will be left with excess stocks that consumers are not willing to buy at the prevailing price. In this situation the market is characterised by what is called excess supply. In order to clear these stocks, producers will have to accept a lower price for their goods. Price will fall until the market is in equilibrium and supply equates to demand. Remember the assumption of perfect information and consider how this will facilitate this mechanism.
- If the price lies below the clearing price, there will be what is termed excess demand. Many consumers will be unable to purchase the goods they are seeking because suppliers have run out of stock. At the prevailing price, suppliers are unable to meet demand. Market forces will eventually rectify this situation as consumers bid up the price until the equilibrium price is reached.

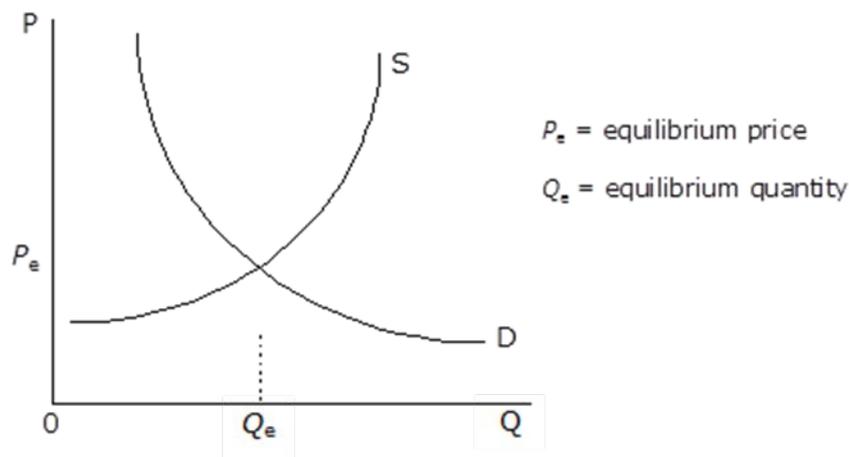
Remember that, in a perfectly competitive market, producers are price-takers. Individually, none of them can effect a price change. All buyers and sellers have perfect information about the quantities available for sale and the prevailing price. If these conditions did not exist then an equilibrium would not necessarily be established at  $Q_S = Q_D$ , although it might well be established at another point. For example, if supply was controlled by a monopoly, the latter could set the price wherever it liked. However, a monopoly is still bound by how much the market demands at any given price.

Now consider a situation where the suppliers are price-takers, but information about market conditions is not widely available. In this case excess supply or demand might persist, slowing down, or preventing altogether, the process of reaching an equilibrium at  $Q_S = Q_D$ .

However, in a competitive environment we have price independently determining where suppliers and consumers position themselves along their respective supply and demand curves. We also have the equilibrium price being determined by the interaction of supply and demand. At the point of equilibrium there is no reason for the market to move away from this position unless either the supply or the demand curve moves. You should recall from the previous two sections the factors that are likely to bring about a shift in either of these two curves.

The supply and demand model can be represented as a figure as shown in 4.5.1, below.

#### 4.5.1 Basic supply and demand



Source: unit author

The supply function shows planned responses to differing levels of price.

If either the supply or demand curve shifts, a new equilibrium price will be created. A shift in the demand curve to the right will raise the equilibrium price. A movement of supply to the right will reduce the equilibrium price.

Importantly the analysis presented assumes that movements/shifts of the supply and demand curves are independent of each other. Making this assumption helps us to illustrate clearly what is meant by a market equilibrium, and the way in which a market clearing price is established.

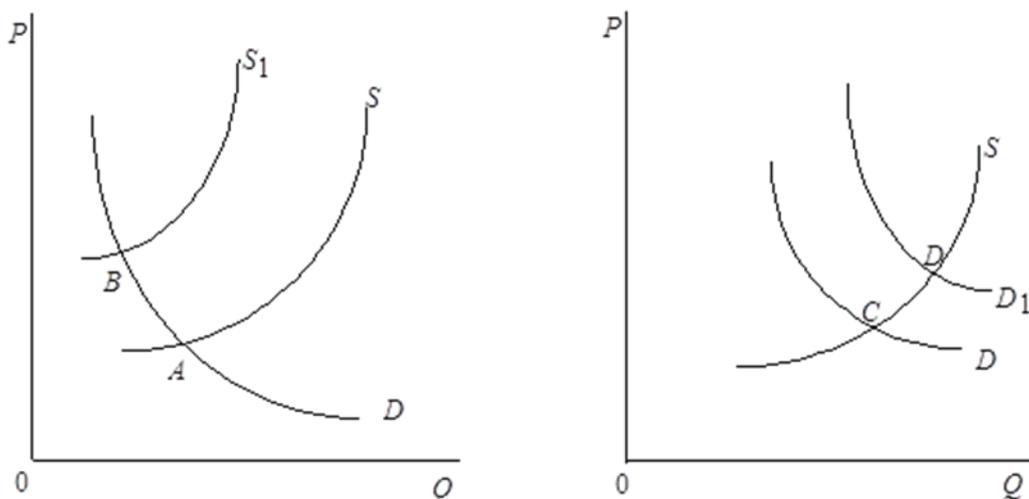
#### Endogenous and exogenous variables

- Exogenous variables are considered to emanate from outside the market in question. They include all those influences such as consumers' preferences, incomes, technological change, the cost of inputs, climate etc.
- Endogenous variables are those which lie within the market system. There are three of them: the price of a good, the quantity of the good supplied, and the quantity demanded.

#### Comparative static analysis

Comparative static analysis means comparing two market equilibria before and after a change. Consider the figure in 4.5.2, below, which illustrates a supply shift and a demand shift. In each case, comparative statics is concerned with comparing the two static equilibria (A, B and C, D) rather than how the market moves from A to B or C to D.

### 4.5.2 Comparative statics



Source: unit author

In each case, the worst mistake would be to say that a change in the good's own price caused the shift in equilibrium. In moving from *A* to *B*, increasing price reduces quantity demanded along the demand curve. However, the new equilibrium was caused by the shift in the supply curve. Note that:

- a shift in the supply curve leads to a movement along the demand curve to a new static equilibrium position (eg at *B*). This could be caused, for example, by an increase in the costs of production, or for one season by bad weather for an agricultural crop.
- a shift in the demand curve leads to a movement along the supply curve to a new static equilibrium position (at *D*). This could result from by an increase in consumer incomes, a change in preferences in favour of the good, a decrease in the price of a complementary good, or an increase in the price of a substitute.

## 4.6 Pareto Optimality

We now turn to the concept of Pareto Optimality, named after the economist Vilfredo Pareto. It is a concept that you will find recurring frequently in the economics literature. The main proposition of Pareto Optimality can be summed up as follows.

An economy is in a Pareto Optimal state when no further changes in the economy can make one person better off without at the same time making another worse off.

You may immediately recognise that this is the socially optimal outcome achieved by a perfectly competitive market referred to above. It can be shown that an economy will be Pareto Optimal when the economy is perfectly competitive and in a state of static general equilibrium. The intuitive case for this is based on the fact that prices

reflect economic values in a competitive market. If a unit of goods or services could produce more or bring greater satisfaction in some activity other than its present use, someone would have been willing to bid up its price, and it would have been attracted to the new use.

When this price system is in equilibrium, the marginal revenue product, the opportunity cost, and the price of a resource or asset will all be equal. Each unit of every good and service is in its most productive use or best consumption use. No transfer of resources could result in greater output or satisfaction.

This can be examined more formally in terms of three criteria that have to be met for a market equilibrium to result in Pareto Optimality. These are that there should be: exchange efficiency, production efficiency and output efficiency.

### Exchange efficiency

Exchange efficiency occurs when, for any given bundle of goods, it is not possible to redistribute them such that the utility (welfare) of one consumer is raised without reducing the utility (welfare) of another consumer.

A simple example of this is where there are two individuals, one with a loaf of bread, the other with a block of cheese. Both can be made better off by exchanging bread for cheese. An efficient exchange system will allow exchange of bread and cheese to take place until neither party can be made better off without one of them becoming worse off.

In a multi-product, multi-consumer economy, exchange is far more complex and involves the use of money to facilitate exchange. However, the principle is the same. So long as products can be reallocated to make one person better off without making another worse off, the economy is operating sub-optimally from the point of view of exchange efficiency. In a perfectly competitive market, exchange will occur until this criterion is met.

Exchange efficiency alone does not necessarily result in Pareto Optimality. This is because it relates only to a specific bundle of goods. It may be possible to make one or more individuals even better off – without making any one else worse off – by altering the bundle of goods produced in the economy. This could involve raising the total volume of goods produced, as well as altering the combination of goods produced.

### Production efficiency

Production efficiency occurs when the available factors of production are allocated between products in such a way that it is not possible to reallocate the production factors so as to raise the output of one product without reducing the output of another product.

This is analogous to technical or production efficiency at the level of the firm. What is being said here is that there are many situations in which it is possible to raise the total output in an economy by simply reallocating factors of production at no additional cost. This is because factors of production are more productive in some uses than they are in others. In a competitive economy, producers bid for factors of production until they are reallocated to their most productive use.

For example, if there is a lot of unproductive, low-wage labour employed in the agricultural sector and labour shortages in the industrial sector where labour productivity is potentially high, factory owners will bid up the price of labour and draw labour from the agricultural sector into the industrial sector. This could significantly raise output in the industrial sector without having a negative impact on output in the agricultural sector. So long as factors of production can be redistributed in a way that increases the output of one product without reducing the output of others, the economy is operating sub-optimally in terms of production efficiency.

### Output efficiency

Output efficiency occurs where the combination of products actually produced is such that there is no alternative combination of products that would raise the welfare of one consumer without reducing the welfare of another.

Both the exchange efficiency and the production efficiency criteria must hold in order for this criterion to be met. The combination of outputs produced according to this criterion is distributed between consumers according to the exchange efficiency criterion, and the economy is operating with production efficiency.

Pareto Optimality is the result of rational economic behaviour on the part of producers, consumers and owners of factors of production in a perfectly competitive economy. Although we don't have the scope to examine the underlying theory here it can be shown that Pareto Optimality will be achieved if all markets are perfectly competitive and in equilibrium.

It is important to realise that, whilst Pareto Optimality is the outcome in an economy that meets each of the three efficiency criteria listed earlier, this does not mean that there is only one 'optimal' allocation of resources. A Pareto efficient economy results in the maximisation of aggregate economic welfare for a given distribution of income and a specific set of consumer preferences. A shift in income distribution changes the incomes of individual consumers. As their incomes change, so too will their preferences, as their demand curves for various products shift to the left or right. This will result in a different equilibrium point in the various markets that make up the economy. Every alternative distribution of income or set of preferences is characterised by a different Pareto Optimum. Thus, since there is an infinite number of different ways in which income can be distributed, there is also an infinite number of different Pareto Optimal equilibriums.

Obviously, in practice, no economy can be expected to attain the Pareto Optimum position. Moreover, the Pareto principle is of little practical use as a policy tool since it is rarely possible to devise a policy that makes someone better off without making someone else worse off. Nevertheless, it is an important concept in the neo-classical tradition of economics and integrates much of the theory. It is also a standard against which economists can explore the real world, where making one person better off almost invariably means making someone else worse off.

## Section 4 Self Assessment Questions

### Question 8

Which of the following are core assumptions of perfect competition?

- (1) Many buyers and sellers, none of whom can individually influence market prices.
  - (2) Homogeneous commodities.
  - (3) No barriers to market entry or exit.
  - (4) Perfect knowledge.
  - (5) Rationality, with firms maximising profits and consumers maximising satisfaction or utility.
- 
- (a) All of the above
  - (b) None of the above
  - (c) Only (1), (3), and (4)
  - (d) Only (2), (3), and (4)
  - (e) Only (1), (2), and (5)

Now read the following paragraph and then answer Questions 9 and 10.

*'Over the past couple of years, grape prices soared because the champagne grape was in short supply; the harvest shrank by about a quarter over this period. Global demand remained unchanged until 12 months ago but if another world recession can be held at bay it is reckoned that champagne sales will grow by about a fifth to a new peak.'*

### Question 9

An increase in the price of champagne grape caused by a cut in the supply of grape would be represented in a diagram of demand and supply curves for grape by which of the following?

- (a) a shift to the left of the demand curve
- (b) a shift to the left of the supply curve
- (c) a shift to the right of the supply curve
- (d) a movement along the supply curve towards the origin
- (e) a movement along the supply curve away from the origin

## Question 10

An increase in the price of champagne itself, caused by economic growth, and an increase in global demand would be best represented in a diagram of demand and supply curves for champagne by which of the following?

- (a) a shift to the left of the demand curve
- (b) a shift to the right of the demand curve
- (c) a shift to the right of the supply curve
- (d) a movement along the demand curve
- (e) no change in the diagram

## 5.0 AN INTRODUCTION TO MARKET FAILURE AND GOVERNMENT FAILURE

### Section Overview

This section provides a brief explanation of why market failure occurs. We also examine reasons why government policy can affect the environment in a negative way.

### Section Learning Outcomes

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

- define what is meant by market failure
- differentiate between the different forms of market failure

### 5.1 Market failure

Neo-classical economics is concerned with markets for goods allocating scarce resources to alternative uses, and prices being established which reflect the scarcity and levels of demand for goods.

Think for a moment about our daily life and what affects it. We live in a particular environment, breathing the air. However, we do not pay a price for the air, since there is no market in air. As a result, we cannot reflect our preference for breathing clean rather than dirty air through the market. This is an example of market failure.

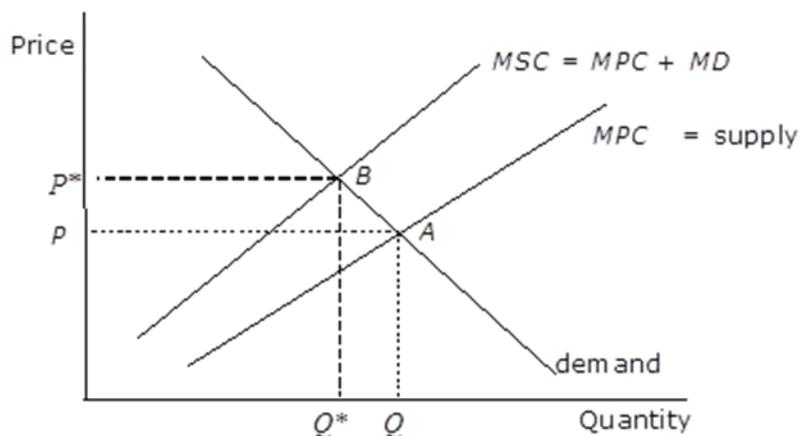
Market failure occurs when the conditions for perfect competition are not met. If the market fails, then government intervention designed to correct the market failure may bring benefits to society. However, government intervention may fail to secure these benefits, it can make matters worse and it can be the reason why there is market failure. This is known as government failure.

We know that the market mechanism will lead to the socially optimal outcome only under very specific conditions. However, it is highly unlikely that these conditions will be fully satisfied. The existence of perfect competition in reality as it is defined in textbooks is highly unlikely. For example, we require that prices will result from the realisation of all possible markets working and existing. This is only likely to occur when a complete and effective system of property rights exists, including property rights to environmental goods such as clean air.

When either condition is not satisfied, markets fail and this can, deliberately or unintentionally, bring about undesirable consequences.

Let us work through the argument for a negative externality. In this case, the marginal private cost (*MPC*) is less than the marginal social cost (*MSC*). The marginal private cost represents the short-run market supply curve. Hence, with a negative externality, the short-run market supply curve is lower than society's short-run supply curve would be. The difference between *MSC* and *MPC* are the marginal damages (*MD*). *MDs* are the amount of the negative externality which as the quantity of output increases, increase as well. These are damages being inflicted on society as a result of the private producer not taking account of the costs that result from production, such as air or water pollution. This situation is illustrated in 5.1.1.

### 5.1.1 Effect of a negative externality



A shows the equilibrium position with a negative externality. Price is  $P$  and quantity supplied is  $Q$ .

B shows the socially optimal outcome, where price is  $P^*$  and quantity supplied is  $Q^*$ .

Hence, with a negative externality, too much of the externality-producing good is supplied at too low a price (relative to the optimum).

This is an example of market failure. It results from the absence of property rights and a market for the marginal damages produced by this activity.

Source: unit author

## 5.2 Government failure

Having taken note of the possibility that markets might fail, what can governments do to improve the situation? Do you think that government intervention is always successful, or can you think of examples where the government intervention has actually made the position worse?

There are plenty of reasons why government failure can occur. For example, the government may come under pressure from certain groups in society and act in the interests of these groups rather than in the interests of society as a whole; there may be a lack of information resulting in the best policy decisions not being taken; and politicians and bureaucrats may not have the goal of maximising society's welfare.

A classic example of government failure that has resulted in environmental harm is the Common Agricultural Policy (CAP) of the European Union. Historically, the CAP has supported farmers' incomes through the use of high product prices. This has led to overproduction and intensive farming. Some of the results of this have been a reduction in hedgerows, leading to a loss of habitat; surface and ground water pollution; overgrazing and pollution from ammonia emissions from livestock farming. More recently, in an effort to correct these government failures, policy has been introduced that offers farmers financial incentives to provide the level of environmental quality desired by society.

There are plenty of other examples of how government policy has resulted in environmental degradation. For example, energy policies have often increased environmental problems. This is because energy use has frequently been subsidised, leading to a wasteful use of energy. This has increased air pollution and problems of waste disposal.

## Section 5 Self Assessment Questions

### Question 11

What is meant by 'market failure'?

### Question 12

What happens to the level of output produced when there is a discrepancy between private and social costs?

## UNIT SUMMARY

In this unit, we looked at the linkages between the environment and the economy.

We defined the environment as including the atmosphere, all flora and fauna, and energy and material resources, and stated its main uses for the economy as

- a supplier of resource inputs
- a supplier of public consumption environmental or amenity goods
- a waste sink

We looked at the difference between degradable and cumulative pollution and noted that, in mathematical terms, stock of degradable pollutant at time  $t$  is given by

$$S_t^a = F_t - A_t$$

Stock of cumulative pollutant at time  $t^*$  is given by

$$S_{t^*}^c = \sum_{t_i}^{t=t^*} F_t$$

where

$F_t$  is the positive flow in a year

$A_t$  is the amount assimilated in a year

$t_i$  is the starting date for emissions

The natural laws (that is, the first two laws of thermodynamics) which the environment obeys, mean that increased extraction of minerals leads to an increase in wastes; there is a limit on the substitutability of inputs; and, since production and consumption lead to the dissipation of matter, scarce energy is needed for recycling.

Recycling was examined in more depth, leading to the following conclusions

- not everything can be recycled
- recycling uses scarce resources, so may not be either economically or environmentally desirable

The unit then considered the scope of environmental economics.

Many of the key economics concepts and principles that will be encountered in this module were then introduced. In particular, the basic economic model and key concepts were introduced. Specifically, we explained both supply and demand and how their interaction leads to a market equilibrium. We then introduced various types of elasticity which can be used to examine how changes to market prices/quantities will be reflected in changes in behaviour.

Finally, the ideas of market failure and government failure were introduced. The importance of market failure is at the heart of many of the reasons why we need to have environmental policy. The impact of market failure on the efficient allocation of resources was introduced, as was the impact of government failure on resource allocation.

## UNIT SELF ASSESSMENT QUESTIONS

### Question 1

Using the Key Readings, draw a diagram that captures the three functions that the environment provides when interacting with the economy.

### Question 2

Write a short paragraph giving examples of the ways in which a production activity such as agriculture might impact upon the environment.

### Question 3

Write a short paragraph about the relationship between neo-classical environmental economics and ecological economics.

### Question 4

Draw a diagram to show the effect on prices and quantities, relative to the socially optimal outcome, of a positive externality.

### Question 5

Give an example of the way in which the three main uses of the environment overlap and can conflict.

## Question 6

Demand for carrots (kg per week)	Price of carrots (£ per kg)
110	1.10
120	0.80
130	0.60
140	0.50
150	0.40
160	0.35
170	0.30
180	0.27

Using the table above calculate the price elasticity of demand for carrots for a price change from 0.60 to 0.80

- (a) with reference to the initial price and quantity
- (b) with reference to the final price and quantity
- (c) using an average of the initial and final prices and quantities

Explain the usefulness of the third answer you calculated.

## KEY TERMS AND CONCEPTS

ecological economics	a branch of economics that places significant emphasis on the physical linkages between the economy and the environment
entropy	a measure of disorderliness of energy
environmental economics	the branch of economics dealing with the environment
externality	an unintended consequence, good or bad, of the actions of another economic agent
government failure	when government policy brings about undesirable outcomes
market failure	when a market does not functioning properly or does not exist
neo-classical economics	an economic paradigm that places markets at the heart of efficient resource allocation
political economy	the study of the interaction between the economy and politics
precautionary principle	actions to prevent/stop environmental loss should not be delayed because of scientific uncertainty
public goods	a good which is non-rival and non-excludable