3

Neoclassical Economics

This chapter addresses the orthodox economics paradigm, and why its theoretical underpinnings might be especially challenged by the environmental problems that we are facing. We begin by identifying how its particular view of the world deals with environmental issues. Economics has its own particular jargon and method (involving a considerable amount of mathematics and graphs) and, although I have kept these to a minimum, this may prove challenging to some readers. I hope that the argument will still be clear. This chapter presents the bones of the neoclassical approach and the proposals of the earliest orthodox economists to address the environmental problem. Environmental economics, which is covered in the following chapter, shares many of the assumptions and methods of the neoclassical approach. To some extent the division of this body of thought into two chapters is pragmatic, although it seems fair to say that the theories and theorists covered in Chapter 4 have made the environment central to their study, and that their work tends to have emerged since environmental problems came to the fore, from around late 1960s onwards.

This chapter begins by outlining the work of two early 20th-century economists who addressed environmental questions in their work. Section 3.2. then looks the issue of resources from an orthodox economics perspective and describes the market view of how resources are distributed within an economy. Section 3.3 looks at efficiency in more detail and explains the process of cost-benefit analysis. Section 3.4 then considers one aspect of pricing economic activity: the process of discounting. Finally, Section 3.5 presents a case-study of a market solution to one specific environmental problem: sulphur dioxide emissions.

3.1. *The Environment Begins to Impinge on Economics*

Chapter 1 included discussion of the first economists who considered the impact of the economy on the environment. In this section we consider the contribution made by two 20th-century economists: Pigou and Coase.

Arthur Pigou was one of the first economists to discuss the problem of pollution. His work on welfare economics, published in 1920, argued an early version of the 'polluter pays principle' and proposed the introduction of taxes on businesses that generated pollution. This was justified on the basis that, in producing the pollution, factories transfer a cost from themselves to the public, and that government is therefore justified in reassigning that cost back to the factory in the form of a tax. Although neoclassical economists are generally opposed to government intervention in markets, it can be justified in this case because the pollution represents an 'externality'[1] and that is a legitimate reason for government involvement.

The key concern from this perspective is to work with markets to increase their efficiency, and so the objective is to set the right level of the tax to achieve the 'optimal' level of pollution that allows the product to be made. The definition of a Pigouvian fee is 'a fee paid by the polluter per unit of pollution exactly equal to the aggregate marginal damage caused by the pollution when evaluated at the efficient level of pollution.' (Kolstad, 2000: 118).

Figure 3.1. Setting a Pigouvian Fee

Figure 3.1 illustrates how the level of such a fee is established. In the graph the lower line is the cost curve of the producer, who uses the environment for free when producing pollution. The steeper curve is the cost to society from the pollution generated by the production process. According to supply-and-demand theory, the producer will fix his production where the price curve intersects with his cost curve. If a Pigouvian tax is introduced the cost curve will shift upwards so that it coincides with the social cost curve, which represents the cost of production as well as the costs to society of by-products of the production process. With the externality of pollution internalized by tax the producer now faces the full cost of their production and will produce a lower quantity. The grey shaded area represents the revenue from the tax. According to economic theory, just imposing this tax will have rectified the market failure caused by the pollution; there is no need to pay the revenue to those who suffered from the effects of the pollution.

In this example we have seen that society as a whole is recompensed for pollution produced by an individual factory. In 1937 Ronald Coase approached the same problem in a different way, by arguing that the problem of externalities can most efficiently be resolved as a market transaction between individuals: the producer who creates the pollution and the victim of that pollution. This solution, known as the 'Coase theorem', is based on the assignation of 'property rights' to the individuals, rather than finding a social or political solution involving government.

Figure 3.2. Illustration of the Coase theorem
[Figure 4--Figure 11.2 from Hussen pp. 229 – but simplified]

The Coase theorem suggests that, so long as a property right is assigned, the outcome of the negotiation between the two parties over the negative effects of the pollution will be efficient. It is usually demonstrated by means of an example. Hussen (2000) uses the example of two businesses—a paper-mill and a fish-farm—who share the use of a river. The paper-mill is upstream of the fish-farm and releases a certain amount of effluent from its paper-making into the river, which threatens the operation of the fish-farm which is situated downstream. The situation facing the two firms is presented in Figure 3.2. The MCC curve is the cost the paper mill will face in using other means of cleaning rather than the river; the MDC curve is the marginal cost of damage caused to the fish farm by discharges from the paper-mill. The natural equilibrium is at point S, where pollution is at level W_e. Coase argued that this will be the case regardless of who owns the property rights. In other words it is unimportant whether paper mill has the legal right to pollute the river, or whether the fish-farm has the legal right to clean water.

If we first try assigning the ownership of the river to the fish-farm it would prevent all emissions from the paper-mill (position 0 in the graph). But if the mill were to discharge less than W_e of waste, the cost of alternative means of cleaning would be greater than the damage to the fish-farm (MCC > MDC), giving the mill an incentive to pay the farm for the damage resulting from some level of pollution. There is a range of costs for this compensation (in the range from 0 to C_1 on the diagram) representing the range of options where the marginal cost of alternative clean-up is greater than the damage to the fish-farm.

The Coase theorem argues that, so long as property rights are clearly defined, it makes no difference who they are assigned to. This suggests that the same procedure of negotiation to achieve an economically efficient outcome would be possible if the ownership of the river had been assigned to the paper-mill. In this case the paper-mill could discharge all its waste into the river, polluting the river to a level represented by the point X on the axis. But for all levels of waste between W_e and X (MDC > MCC) the paper-mill would gain more financially by engaging in a negotiation to reduce its level of its emissions and take a fee from the fish-farm in return. So from this perspective also the optimum level of pollution is W_e, where MDC = MCC.

The Coase theorem is appealing to neoclassical economists because it reduces the role of government to that of merely assigning property rights. However, there are several flaws with it. As demonstrated in the example just given, it relies on a world where the origin of the pollution is clear—this is not the case with many of the most serious sources of environmental pollution. It can also be criticized for being totally pragmatic and not paying any heed to who is responsible for the pollution, thus flying in the face of the 'polluter pays' principle. The theorem is based on the premise that it is irrelevant in efficiency terms where the right to pollute is assigned. However, this is far from irrelevant in terms of the distribution of income and well-being. Perhaps most seriously of all, the Coase theorem was developed in a simple situation involving two producers and two possible victims both living in the same jurisdiction. This can have little relevance to the most serious environmental problems that face us, which 'transcend national boundaries, involve irreversible changes and considerable uncertainty, and call for a coordinated, multifaceted response by a large number of nations' (Hussen, p. 231). Effectively the negotiation and decisions costs of a private bargaining solution will rise rapidly the greater the number of stakeholders involved. This means in real life situations this approach become impractical.

3.2. *Price, Scarcity and Substitutability*

Neoclassical theory was intended to be neutral and value free: like Newton's laws of physical motion it aims to define a set of laws governing economic activity. Forces of supply and demand interact to achieve optimal outcomes for all. Economic decisions, including those about non-price environmental goods and future generations, are made on the basis of 'utility maximization', a means of ensuring that the preferences of as many economic agents as possible are fulfilled to the maximum extent possible given the limitations of available resources. Although the economy is a dynamic system with a multitude of individual players, none the less it reaches an equilibrium where these forces are in balance. This Promethean view of the boundless expansion of human ingenuity can be identified with the optimism of the 19th century, when technology was allowing increasing mastery over nature and man's power seemed limitless.

How does the environment intrude into this picture of almost divine order in economic systems? Several of the key concepts that guide a neoclassical economist are problematic when applied to what is increasingly being recognized as a limited natural environment. An economist will talk about the 'exploitation of resources' without any concern about the moral implications of the phrase. As we are told by the *Oxford Dictionary of Economics*, 'This is an entirely value-free usage; it is contrasted with the perjorative usage'. From this perspective, the earth's resources are freely and unproblematically available for our use. Another key concept in economic theory is that of 'economies of scale', which is defined as 'The factors which make it possible for larger organizations or countries to produce goods or services more cheaply than smaller ones'. Although attention is also paid to diseconomies of scale, orthodox economy theory suggests that that there is an in-built tendency for enterprises to grow in order to benefit from these scale economies and thereby increase profits. This runs counter to the concern of ecological and green economists for limits to growth.

An externality is a consequence of economic activity that does not impinge on the person or business conducting that activity. Economic theory suggests that there are positive and negative externalities, but from the perspective of the environment it is the negative externalities that concern us. Any sort of pollution would be defined as an externality by a neoclassical economist—a factory can produce plastics and release dioxins into the air free of charge. Their release does not impinge on its production and does not feature in its cost calculations. The negative consequences of the emissions are borne by society at large or, more likely, by a small number of people living close to the factory. From the perspective of an economic theory that considers the market to be a self-regulating and optimal system, the existence of these negative consequences is problematic. They are defined as 'market failure'. The fact that there are levels of pollution which seriously impair the health of environmental and social systems must, within the economic system, be seen as an example of 'market failure', because according to a neoclassical economist, if the market were operating successfully then any negative effects would be self-adjusting.

Neoclassical economists are also relaxed and optimistic about scarcity. As we saw, they believe that the market will allocate goods efficiently and the price signal is a key part of this process. Prices communicate information about how scarce a good or service is, relative to the demand for it. In other words, the price is set in terms of the relationship between the supply of a good or resource and the demand for it. Thus the price mechanism can do the job of protecting scarce resources for us. As a resource becomes more scarce its price will rise and demand will fall—automatically protecting the resource.

Scarcity is also a relative rather than an absolute concept, since if one resource becomes depleted another can be used as a substitute:

> If it is very easy to substitute other factors for natural resources, then there is, in principle 'no problem'. The world can, in effect, get along without natural resources. Exhaustion is an event not a catastrophe . . . If, on the other hand, output per unit of resources is effectively bounded – cannot exceed some upper limit of productivity which is, in turn, not too far from where we are now – then catastrophe is unavoidable . . . Fortunately, what little evidence there is suggests that there is quite a lot of substitutability between exhaustible resources and renewable or reproducible resources (Solow [1993- p.74], quoted in Gowdy and Hubacek 2000)[2]

Hence, as demonstrated by the story in Box 3.1, neoclassical economists are not concerned about the depletion of natural resources, since they believe human ingenuity will resolve this problem by finding substitutes (see the further discussion of this in Chapter 10).

Box. 3.1. A Cornucopian Matches up to Profit of Doom: The Ehrlich–Simon Wager

Neoclassical economists subscribe to an optimistic view, where the limiting factor on human progress is human imagination, which can overcome any biophysical or environmental constraint:

The major constraint upon the human capacity to enjoy unlimited minerals, energy and other raw materials at acceptable price is knowledge. And the source of knowledge is the human mind. Ultimately, then, the key constraint is human imagination acting together with educated skills. This is why an increase in human beings, along with causing additional consumption of resources, constitutes a crucial addition to the stock of natural resources. (Simon, 1996: 408).

Simon was writing in direct challenge to the concerns of environmental campaigners that the economic system was itself putting pressure on the planet and running up against planetary limits. As the quotation makes clear, Simon was unconcerned with either population growth or limits on the supply of energy or resources. He famously debated these issues publicly with Paul Ehrlich, author of *The Population Bomb* and a prominent environmental writer and campaigner (see more in Chapter 2). The debate culminated in a public wager that the price of five metals commonly used in production processes would not increase over a fixed time-period. Simon was relying on the economic theory that suggested scarcity would be reflected in price signals and that, therefore, if the supplies of these metals were declining their prices would increase.

Ehrlich accepted the wager and chose the following metals: copper, chromium, nickel, tin and tungsten and the date of 10 years ahead, i.e. 1990. At the end of the ten-year period the price of all the metals had actually fallen, Ehrlich lost the bet and paid Simon. Simon had proved that the prices of the commodity metals were falling but did this actually prove anything about their exhaustion? Economic theory would suggest that, as a material becomes more scarce, 'substitution' takes place, i.e. technologies and processes are designed that reduce the demand for this material. In the case of copper, for example, fibre-optic cables were invented and developed, actually reducing the demand for cooper. There are several variables that influence the price of commodities, not scarcity alone, so the falling prices need have had no direct connection with the biophysical limits on the availability of these metals. Ehrlich's mistake was to accept the wager on Simon's home ground—his agreement to gamble on the future value of commodities indicates his limited knowledge of how markets function rather than a fundamental mistake about whether the economy needs to respond to environmental limits. As a simple example, much of the fluctuation in the price of commodities is the result of futures trading rather than a response to the level of supply.

3.3. *Markets, Allocation Efficiency and Assessing Outcomes*

The most important aspect of a market system, the reason given for its superiority to other forms of economic organization, is efficiency. So what do economists mean by efficiency? The understanding of efficiency was greatly influenced by the work in welfare economics of Vilfredo Pareto. In simple terms they mean that a distribution of whatever resource is efficient if no one person who is receiving some of that resource cannot receive more without another person receiving less. This is simplified even further in Figure 3.3, which considers the allocation of a scarce resource between just two people, person A (x axis) and person B (y axis). The figure illustrates the 'efficiency frontier' for the allocation of a good between two people; when the goods are allocated efficiently the total value allocated is $100. At point d person 1 received all of the good; at point 3 person 2 receives all of the good. At points in between, and along the frontier, allocations are more or less equal but all are efficient. Anywhere within the frontier, say point a, where each person receives an amount of the good worth $25, the allocation is inefficient, since by moving to the frontier, either one person or the other could receive more of the good. From point a, a move could be made to either point b or point c, allowing an increase in utility represented by the shaded triangle. It is notable that this allocation model does not concern itself with the relative shares acquired by the two people.

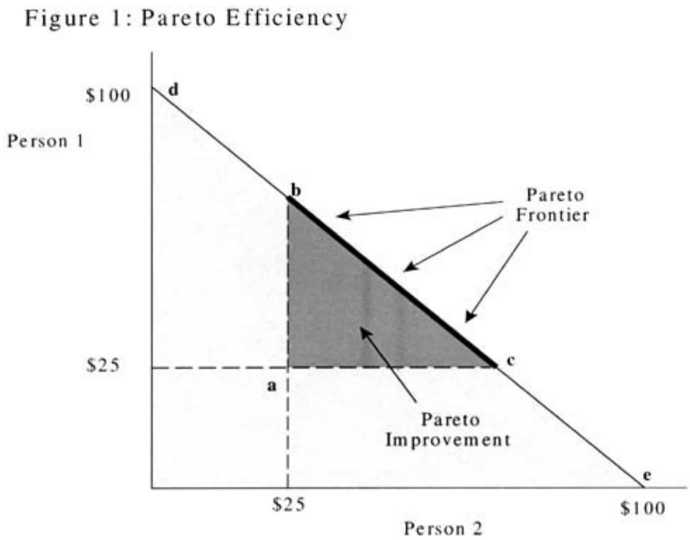

Figure 3.3. Pareto-efficient distribution

For a neoclassical economist it is a fundamental truth that markets produce the most efficient outcomes, in the Pareto sense. That is why market systems are superior to other forms of economy. There is no need for policy-makers to act, since the 'invisible hand' of the market will automatically achieve this efficient outcome.

Almost all neoclassical economists accept the need for governments to play some role in the economy, and these policy-makers require information before making a decision about the likely outcomes. When deciding which policy choice is better from a societal perspective conventional economists turn to the cost-benefit analysis. This is a technique to measure the optimality—in a Pareto sense—of the outcomes of a particular policy such as building a new road, or cutting down a forest. The CBA begins by defining clearly what is being measured: what time-period is being considered, exactly what changes will be made, whose welfare is being included in the equation. The next stage is to identify all the physical impacts of the project before the most difficult stage of all: costing the impacts. All the equations are worked in monetary values, which means that a monetary cost must be calculated for any positive of negative impact. In addition, a discount rate is applied, to allow for the fact that costs and benefits may not have equal real value at different periods in time. This technique, which can have a huge impact on the likelihood of a policy being introduced, is discussed in the next section.

Environmental economists have criticized conventional CBA for not costing in certain features—say the economic value of a view—which are hard to price. Heinzerling and Ackerman call cost-benefit analysis a 'deeply flawed method that repeatedly leads to biased and misleading results'. They criticize the central assumption of the method, i.e. that the issues of concern when decisions are made can be translated into monetary terms. They challenge CBA's two central claims to superiority as a decision-making tool: the achievement of efficient allocations and objectivity/transparency. CBA cannot assure efficient allocations, they claim, because it reduces costs to individualist financial costs, which is not the way humans actual assess the consequences of decisions, either for themselves or their environment. As far as transparency and objectivity are concerned, Heinzerling and Ackerman suggest that the method assumes a particular worldview (a monetized, individualist one) which is far from objective, and the process itself is so cumbersome and complex that only experts or wealthy citizens can afford to engage with it.

3.4. *Discounting the Future*

The consequences of many environmental losses and impacts are likely to be felt many years into the future. In the case of climate change we may be talking about 2050 to 2100; in the case of nuclear pollution we are talking about hundred of thousands of years. This represents a significant problem for economists whose techniques are based on markets and prices, since they need to be able to say what those prices are likely to be many years ahead. To achieve this they use a technique known as 'discounting'. This translates the environmental impact from the future into a present value which is expressed as:

$$PV(B) = B_T/(1-r)^T$$

where r is the discount rate, and B is the benefit or cost (C) accruing in T years' time. Such a formula has the effect of diminishing the impact of environmental destruction caused in this present time-period and making our current actions appear less costly to future generations.

When working out the costs and benefits of any economic policy or production process over time the outcome depends entirely on the discount rate that is applied. The higher the discount rate, the lower the future costs of current actions. Some economists favour an approach to discounting that is called 'descriptive', which assumes that the discount rate should just be equivalent to the prevailing interest rate. If interest rates are relatively high, say 5-10 per cent, then the cost of any actions we take now that have negative environmental impacts will weigh very little, since the discount rate has the effect of massively diminishing the present value of the distant future. The alternative approach to discounting is known as the 'prescriptive' approach and is based on the sense that, although rates of interest as high as those quoted are possible, people making long-term investments tend to choose less risky option, such as long-term government bonds, which have much lower returns, more in the range of 1-2 per cent or less above the rate of inflation.

The discount rate is made up of *pure time preference* and *wealth* components. The 'pure time preference' component is a source of much debate since, at least within the course of a human life, it should be zero, jam today and jam tomorrow having equivalent utility value, in the economic jargon. However, experiments and everyday experience suggest that in reality people are impatient and prefer to have things now rather than later, suggesting that they have a positive time preference. Somewhat ironically, the suggestion that we ourselves are undermining the possibility of future life for human beings on earth may actually greatly increase our time preference for present consumption.

The wealth component is based on the assumption that incomes will rise, so that future generations will be richer than the present one. So if we are concerned with equity we should do less to protect future generations who we assume will be richer than we are:

> The source of the paradox is the assumption that future generations will be better off than we are; in this story, we are the poor, and those who come after us are the rich. If that were true, then as modern Robin Hoods we could strike a blow for equality by taking money from our children's inheritance and spending it on ourselves today. (Ackerman, 2009: 87).

Again, there is an obvious problem with this line of reasoning, since the idea of ever-increasing consumption is itself based on the economic growth that may be destroying the potential for future generations to enjoy their comfortable lives. In this sense we might reasonably suggest a negative wealth component to the discount rate.

Some would argue that the only legitimate discount rate is zero, since all generations' preferences should be treated equally and the time at which somebody lives should not affect their right to an equal quantity of well-being. If we take a more conventional economic view, that impacts today will be of less importance in the future, we can begin to try to calculate what rate of discount might be appropriate. The rate we choose is dependent on a range of variables: our preference for consuming today rather than tomorrow; how much our consumption is worth to us (which relates to how much we already have, so that it is higher for poorer people and countries); and the rate at which national consumption is increasing (which relates also to population growth rates).

Table 3.1 gives estimates made by the World Bank for national discount rates in 1990. [update these?] You can see that for poorer countries the discount rates are negative, meaning that future consumption there should be valued more than present consumption and these countries should have very protective attitudes towards the environment. This is not found in reality, suggesting a flaw in the theory of the discount rate. The rates for developed countries are high, which, if they were applied to environmental problems, would mean that we would make little effort to protect the environment since the discount rate would suggest that, not so far into the future, the impact of our present behaviour would have been greatly diminished.

Table 3.1. *Estimated of Discount Rates for a Range of Countries, 1965-88*

Country	Growth of real private consumption (1)	Growth of population (2)	Discount rate (%) (1 – 2)
USA	3.3	1.0	+2.3
UK	2.8	0.2	+2.6
Japan	5.0	1.0	+4.0
Ethiopia	2.4	2.8	-0.4
Ghana	1.7	2.6	-0.9
Chile	0.8	1.7	-0.9
Thailand	5.8	2.5	+3.3

Source: *World Development Report*, 1990 (World Bank, 1990).

While this may seem an arcane and technical discussion, it is one which has an enormous impact on our chances of protecting our environment.

These discount rates are applied when future impacts of current policies are calculated, and if the equations are in error then we risk huge future damage to our environment. How this has impacted on the problem of climate change in particular is discussed further in Chapter 10.

3.5. *Case-Study. SO2 Allowance Trading*

'Acid rain' was one of the first environmental problems that could be scientifically proved to be caused by specific pollution processes and was therefore an important test case for how such harmful pollutants might be controlled on a national scale. Acid rain is caused by the dissolution of pollutants from the burning of fossil fuels (especially in power stations) in rain or other precipitation. Although it was first identified in the 19th century, it increased in spread and intensity as the burning of fossil fuels expanded. The most significant gas that causes acid rain is SO_2 or sulphur dioxide. This case-study explores the consequences of a market-based policy to control SO_2 emissions introduced in the USA.

The scheme was introduced following the passage of the Clean Air Act amendments in 1990. Title IV of these amendments established an allowance trading programme for SO_2; its aim was to cut emissions by 50 per cent, or some 10 million tons, by 2000. The scheme worked by allocating the right to produce sulphur dioxide to electricity generating plants and allowing them to trade their quota between themselves:

Individual emissions limits were assigned to the 263 most intense SO_2emissions generating units at 110 electric utility plants operated by 61 electric utilities, and located largely at coal-fired power plants east of the Mississippi River. EPA [the Environmental Protection Agency of the US government] allocated each affected unit, on an annual basis, a specified number of allowances related to its share of heat input during the baseline period from 1985-87, plus bonus allowances available under a variety of provisions. . . Cost-effectiveness is promoted by permitting allowance holders to transfer their permits among one another, so that those who can reduce emissions at the lowest cost have an incentive to do so and to purchase permits from those from whom reducing the cost would be greater. Allowances can also be 'banked' for later use. (Stavins *et al.*, 1998: 70-71).

From a neoclassical perspective, a trading scheme can achieve an efficient outcome because those who can most easily and cheaply reduce their emissions will do so, and will sell their permits to those whose production processes mean that it would be more costly for them to reduce emissions. Thus the least-costly solution to the problem is found. Even within the market paradigm, there are problems with such a trading scheme. Rights are allocated on the basis of past polluting behaviour, so that the heaviest polluters are given the greatest allocation (this is a process commonly known as 'grandfathering'). This creates what economists call a 'moral hazard' since polluters may be expected to resist cleaning up their act, or even polluting more, if they expect that a trading regime may be introduced. In the case of the SO_2 scheme it appears that the moral hazard was minimised, as allowances were granted on the basis of baseload contribution to the grid, rather than emissions, so that more efficient plants were not penalized. More radical economists would question the allocation of the value generated by the permits. If a right to permit any pollution is created and allocated to companies who can then sell it, a public right (to pollute) has been privatized and sold. Yet the value of this right, that was public, has been given to private companies free of charge—and they can profit from selling it.

The practical outcome of this scheme was impressive. The targets that were set for reductions were achieved and even exceeded. However, this in itself led to a problem, since companies were able to 'bank' a large number of allowances, raising questions about whether the limits originally agreed were sufficiently stringent. Estimates have been made of the cost savings generated by the scheme, a figure of $1 billion annual savings being quoted. Although such schemes may indeed create efficiency savings, it is hard to measure these in practice, since it is a difficult exercise valuing something that never happened, i.e. the reductions that might have been brought about through a system of regulation. The damages caused by pollution—especially in the case of pollution that is deadly to human health and whose results express themselves over many years and even generations, as is the case with radioactive pollution—are extremely difficult to measure accurately. The process of setting limits is also fraught with difficulty and subject to political pressure from both environmentalists and those lobbying for companies who generate the pollution.

Market solutions are popular with economists and polluters: the former because they have faith in markets; the latter because they gain the value of them. Taxes tend to be more popular with policy-makers and environmentalists, because the latter tend to distrust the corporations who favour market solutions and the former because they receive the revenue from taxation. So long as the limit on pollution that is fixed initially is strict and is based on scientific findings that are as immune as they ever could be from business lobbying, and so long as the value generated by emissions trading schemes becomes public rather than private property, even the more radical environmental and ecological economists see a role for market-based solutions in promoting efficient responses to pollution control. Other green and anti-capitalist economists challenge philosophically the 'enclosure' of the planet's atmosphere or water courses and their sale to the highest bidder (see more in Chapter 14).

Notes

1. An externality is a key concept in conventional economics and is the term used to refer to an impact on a third party that is not captured by the price paid by a consumer of a good or service, or the price received by the producer of the good or service. The concept is discussed in more detail in Section 11.1.
2. Thanks to Ioana Negru for drawing my attention to this quotation.

Summary Questions

- What externalities can you identify in the business model of a leading supermarket?
- How indicative of its scarcity is the price of a particular non-renewable resource?
- How likely is a cost-benefit analysis of building a new runway at Heathrow airport to take into account all the costs and benefits to all stakeholders?
- What discount rate would you use when assessing whether or not to build a new nuclear power-station?

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