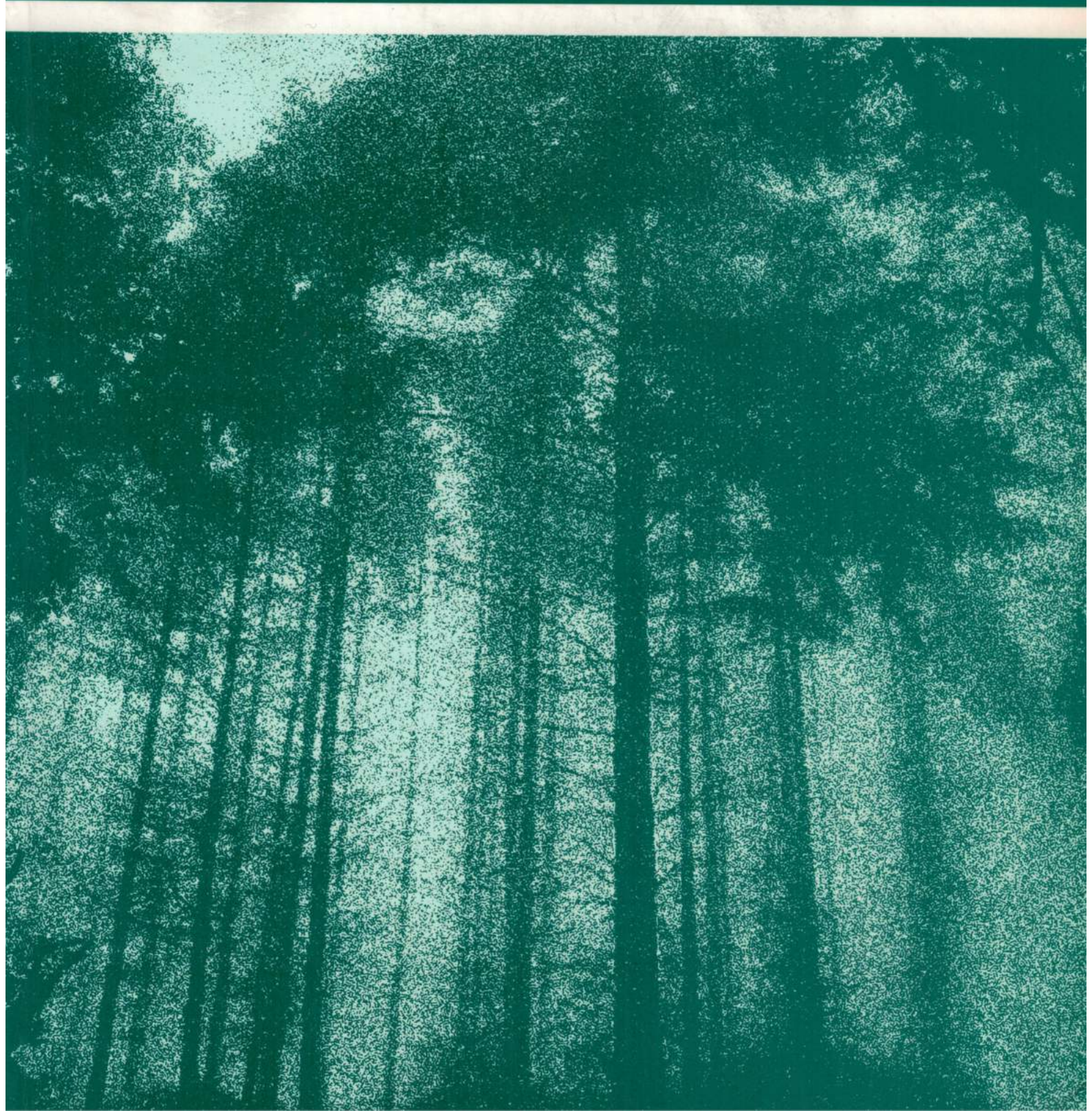


THE MARKET IN ENVIRONMENT

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Robert Taylor



THE MARKET IN ENVIRONMENT

Market Failure, or Market Solutions?

by

Robert Taylor

University of Chicago

Adam Smith

London

1992

MERCHANTS are commonly ambitious of becoming country gentlemen, and when they do, they are generally the best of all improvers. A merchant is accustomed to employ his money chiefly in profitable ways, and chiefly in expense. The one often sees his money go from him and return to him again with a profit; the other, when once he parts with

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A merchant is commonly bold, a country gentleman a timid, undertaker. The one is not afraid to lay out at once a large capital upon the improvement of his land... The other, if he has any capital, which is not always the case, seldom ventures to employ it in this manner... The habits, besides, of order, economy and attention, to which mercantile business necessarily forms a merchant, render him much fitter to execute, with profited success, any project of improvement.

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CONTENTS

1. Introduction

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CONTENTS

1. Introduction	1
2. Market failure and the environment	6
3. Market and non-market environmental policy	11
4. Market environmental policy in practice	29
5. Potential applications of market environmentalism	39
6. Conclusion: a market environmental policy?	51
Notes	53

Bibliographical information

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1. INTRODUCTION

Regulation has always been required and is still required, but it has its shortcomings. For these reasons the Government, along with other governments, has been forced to look for ways to control pollution which are more effective by working with the grain of public opinion. The prospect of a more efficient and responsive response to environmental issues, both old and new, is the focus of this report.

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and the
Institute for Humane Studies**

The Common Inheritance

Suddenly, in Europe, America, and elsewhere, environmental problems have captured the public imagination. In the political realm, parties of the right which have traditionally sidestepped environmental issues - are now having to address perceived problems such as the greenhouse effect and acid rain. A UN conference called specifically to discuss global environmental problems will take place in Rio de Janeiro soon.

The precise cause of this sudden interest is hard to pin. One (much-underrated) explanation is that as incomes have risen in the industrialized countries (and the last ten years has been a period of rapid growth), money matters have begun to take a back seat to 'quality of life' issues. In other words, increasing disposable income has made items such as leisure time, clean air, and public parks relatively more valuable. This account of the rise of environmental concerns in industrialized countries would also explain the relative lack of interest that still prevails among developing countries.

Brazil, host to the forthcoming UN conference, offers a particularly cogent example of the relative indifference of developing countries to environmental problems. While concern has grown over the destruction of Brazil's tropical rain forests, leading some to suggest that the World Bank should offer debt reductions as an incentive for the Brazilians to conserve valuable tropical ecosystems, international pressure has forced the Brazilians into making some reforms in their land policy, which has encouraged deforestation. They have done so reluctantly, however, and are angered at the lack of international understanding of their pressing economic situation. With widespread poverty and urban blight bearing down on the population, Brazil has chosen to make environmental protection a secondary public policy priority.

The more commonsense explanation of public interest in the environment is that various environmental problems have seemingly come to a head in recent

1. INTRODUCTION

"Regulation has always been required and is still required, but it has its shortcomings. For these reasons the Government, along with other governments throughout the world, has begun to look for ways to control pollution which avoid some of these problems by working with the grain of the market . . . market mechanisms offer the prospect of a more efficient and flexible response to environmental issues, both old and new."

This Common Inheritance

Suddenly, in Europe, America, and elsewhere, environmental problems have captured the public imagination. In the political realm, parties of the right -- which have traditionally sidestepped environmental issues -- are now having to address perceived problems such as the greenhouse effect and acid rain. A UN conference called specifically to discuss global environmental problems will take place in Rio de Janeiro soon.

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The more commonplace explanation of public interest in the environment is that various environmental problems have seemingly come to a head in recent

decades. Toxic wastes, radon gas, ozone depletion, acid rain, the destruction of tropical rain forests, the ever-growing ranks of endangered species -- all these recent developments have contributed to a sense of crisis in environmental policy. This has in turn led environmental organizations and other groups of concerned citizens to call for urgent political action.

Unfortunately, that enthusiasm has not been accompanied by clear thinking about environmental problems and their causes. Environmental groups in particular often seem confused about the aims of environmental protection. For instance, the executive director of Greenpeace Canada, Mr Michael Monolson, recently criticized a Canadian grocer for introducing a line of 'green' or 'environmentally safe', products. Monolson admitted that there was a definite 'positive side' to this product line, but complained that the grocer 'didn't introduce the green line out of concern for the environment, but to make money' [1].

In addition, expert scientists have challenged this crisis mentality. The question of just how much the environment has been damaged is hotly contested. Many studies have cast doubt on the reality of global warming, the causes of acid rain, and the seriousness of other environmentalist claims [2].

But whatever the facts concerning environmental distress, the public thinks there is a crisis, and this belief is already being translated into government action. Analysis of the scientific evidence on the true extent of any environmental damage resulting from human actions, though vitally important, is beyond the scope of this report. Instead we will take the objectives of environmental policy, determined through the democratic political process, as exogenous variables and go on to ask whether the policy instruments that are being most widely canvassed, and adopted, are really efficient as well as effective. For, in the words of David Pearce and his colleagues, 'given an environmental policy objective, the aim of society should be to achieve that standard at minimum cost' [3].

MARKET FAILURE OR GOVERNMENT FAILURE?

Environmental distress and economic systems

It is a common enough doctrine that environmental problems have arisen around world because of some inherent flaws in the capitalist economic and political system, now working themselves out; and that only greater central planning and control over crucial environmental resources can correct these problems. But environmental degradation is not unique to capitalist economies. Indeed, the Soviet system has produced many environmental catastrophes (the poisoning of the Aral Sea, for example) and it is now clear to everyone that much of Central and Eastern Europe is polluted by environmentally insensitive factories and plant that would not have been tolerated in the West [4].

The environmental destructiveness of communist economies should not be surprising. Managers in capitalist and communist countries work under different incentives. Capitalist managers strive to maximize profits, an end which is best achieved by satisfying consumers and deploying the most up-to-date and efficient production methods, replacing capital equipment as soon as less wasteful processes become available. Communist managers, on the other hand, are denied the capital accounting concepts that make this continual upgrading possible; so the skylines once hidden by the iron curtain remained dominated by their old-fashioned and crumbling factories belching waste into the skies and rivers. Unable to count the cost, they seek to maximize their own output, at the expense of environmental quality [5].

Market failures and government responses

Most economists (particularly today those who have grown up in the reality of Central and Eastern Europe) agree that the market economy is the most efficient and effective way to produce and distribute goods and services. And again, those who have seen both realities conclude that democratic capitalism does less damage to the human environment as well. This endorsement, however, is not unqualified, and there remains a widespread belief that the market is, by its nature, unable to provide environmental amenities -- from clean air to parks and nature preserves -- a phenomenon that has been labelled 'market failure' by economists.

The reality may be less worrying than the raw theory suggests. But *any* failure of capitalist economies to handle the demand for improved environmental amenities is surprising for several reasons. Market economies serve consumers. Entrepreneurs are constantly scrambling to satisfy consumers and to design innovative products and services for the market. And so we must ask: Why have entrepreneurs not met the increasing demand for better environmental quality? Why has the marketplace failed?

However, we should not rush to condemn the market economy for these shortcomings, since in so many ways it is prevented outright from tackling them. Market failure has become a widely used justification for government intervention in the economy. In regard to the environment, governments have taken the initiative in many supposed market-failure situations by passing legislation aimed at limiting pollution output, removing countryside areas from private ownership, trying to protect endangered species, allocating funds to clean up toxic waste dumps, and so forth. As later examples will illustrate, however, this response has always been expensive and has often been ineffective or even counterproductive. Indeed, government responses to supposed market failure have more often than not compounded the original problem.

Is there an alternative?

The purpose of this report is to present better alternatives to the government environmental programmes that prevail around the world today.

The appellation 'market failure' is a misnomer which suggests that policy should aim at overcoming market forces. In fact, though, the most promising strategy is to help these forces work more effectively, since environmental problems are often the result of poorly defined property rights and of damaging taxes, subsidies, and regulations -- a forced absence of the market rather than any sort of market 'failure'.

An economic system like capitalism, which relies heavily upon individual initiative and decentralized decision-making, must have a properly structured legal framework -- a fire-grate to contain its fire. Defining and establishing this framework is an important and vital role of governments under capitalism. If the legal framework is poorly designed, the market will produce equally poor results. And many of the environmental problems we face today are the product of a legal system that has not correctly shaped the structure of rights and incentives within which capitalism operates.

The environmental challenges which we face do not require a wholesale realignment of our economies. Rather, they require an extension of the legal principles of capitalism. Property rights can be extended to presently unowned resources. Where this solution is impractical, market-mimicking policy rules (eg, effluent charges or marketable pollution permits) may be used to force polluters to take into account the social costs of their production processes. In short, the market can and should be extended to areas where it is presently absent.

Despite widespread belief to the contrary, a market economy and a clean environment are not mutually exclusive. This report, by offering market solutions to market failures, will attempt to dispel this misconception and provide a sound theoretical and policy basis for market environmentalism.

Structure of the report

An understanding of the theory of market failure is essential to students of environmental policy, so Chapter 2 examines the causes of market failure, reviews the responses of orthodox economists, and presents theoretical work done by liberal economists which casts the market-failure debate in a new light.

That work constitutes the theoretical foundation for market environmentalism, and its insights can be used to formulate a market-oriented programme for improving environmental quality at a cost far lower than intrusive regulatory schemes. Exploring this, Chapter 3 reviews present environmental policies, examines the policy proposals of free-market environmentalism, and compares the two according to the criteria of efficiency, equity, and ethicality.

Finally, Chapter 4 and Chapter 5 follow up this examination of market environmentalism with a look at actual and potential applications of its principles to real environmental problems. The theoretical foundations laid in the previous chapters are substantiated with empirical evidence and used as the basis of suggested reforms.

"Resource held as part of a decision maker's wealth will seldom be squandered."

Richard Stroup and John Eadington

Any serious analysis of environmental problems must begin with the theory of market failure. Environmental amenities are simply economic goods, demanded by consumers in the marketplace. Generally speaking, market economies do a good job in meeting consumer demand. In some circumstances, however, the market fails to discharge this task.

Such failure appears to occur with a number of important environmental goods. So why exactly should the market in some situations fail to produce clean air and water, nature preserves, and wildlife conservation — goods that many individuals seem to desire?

The taxonomy of market failure

Economists have isolated two qualities of goods and services that contribute to market failure: nonexcludability and nonrivalrous consumption.

Nonexcludability occurs when the producer of a good is unable to keep nonpayers from consuming the good. National defence is a good characterized by nonexcludability: once it has been produced, its benefits cannot be limited only to those who are willing to pay voluntarily.

Nonrivalrous consumption occurs when the marginal cost to a seller of providing a good to an additional consumer is zero, that is, any number of consumers may enjoy it without detracting from the enjoyment of others and without incurring any additional costs upon the producer. One good that has some of this quality is a cinema: any number of patrons (up to the point of capacity) may enjoy a film without significantly affecting either the enjoyment of other patrons or the costs of the owner.

Using these two qualities we can construct a taxonomy of market failure. Figure 1 represents the four components, or quadrants, of this taxonomy.

2. MARKET FAILURE AND THE ENVIRONMENT

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Figure 1: Taxonomy of market failure

	rivalrous consumption	nonrivalrous consumption
excludable	PRIVATE GOODS	PUBLIC GOODS
nonexcludable	COMMON GOODS	COLLECTIVE GOODS

The quadrant in the upper-left corner represents **private goods**. These are characterized by both excludability and rivalrous consumption and so do not contribute to market failure. Examples include chocolate bars, raincoats, and bicycles.

The quadrant in the lower-left corner represents **common goods**. These goods display nonexcludability but not nonrivalrous consumption. A good example of a common good is an unowned but widely used stream: no one can be prevented from using the stream, but the use of the stream by an individual (eg, a polluter) often does detract from others' enjoyment.

The quadrant in the lower-right corner represents **collective goods**. Collective goods have both the qualities of nonexcludability and nonrivalrous consumption. The classic example, already mentioned, is national defence: once such a good has been produced, nonpayers cannot be excluded, and one person's consumption of the good does not detract from anyone else's consumption.

Finally, the upper-right corner represents **public goods**. Public goods entail nonrivalrous consumption, but exclusion of nonpayers is possible. Once again, the private cinema offers a good illustration of a public good: the owner of the cinema can easily exclude those consumers who refuse to pay admission, but the additional cost to the owner and other patrons of admitting another customer is close to zero (up to the point of capacity).

THE ORTHODOX THEORY OF MARKET FAILURE

Nonexcludability

Common goods and collective goods are both characterized by nonexcludability. The inability to exclude nonpayers leads to a 'free-rider' problem -- certain individuals may benefit from a good without paying for the good's production, and such individuals are called free riders.

Free-riding can lead to the overuse and exploitation of **common goods**. Because no one has the power to exclude others from the resource, it will be used by individuals without regard for the costs imposed upon others. Garrett Hardin has discussed this problem in a now famous piece entitled *The Tragedy of the Commons* [1], perhaps drawing on earlier surveys by David Hume in the eighteenth century [2] and Scott Gordon in the twentieth [3].

The atmosphere provides a good example. Arthur C Pigou used the example of atmospheric pollution to illustrate his well-known distinction between private and social costs [4]. Pigou argued that because polluters did not take account of the costs which their pollution imposed on neighbouring landowners, production (and the consequent output of pollution) would proceed at an inefficiently high level. By taxing the pollution of the relevant factories (for example, with effluent charges), the private costs of production could be brought in line with the social costs of production (which include both private costs and the costs imposed upon other parties), and pollution would fall to an efficient or socially 'optimal' level.

The obstacle which nonexcludability poses for the private production of **collective goods** has long been noted. Adam Smith, for instance, recognized this problem and felt that the government would have to erect and maintain

those public works which, though they may be in the highest degree advantageous to a great society, are, however, of such a nature, that the profit could never repay the expense to any individual or small number of individuals [5].

Why did Smith, otherwise a champion of the market economy, believe that private provision of collective goods was out of the question? The reason was that the nonexcludability of collective goods tempts consumers to free-ride: why pay for a good that you can get for 'free'? But unfortunately, free-riding, of course, may substantially reduce any revenues to the good's producer, leading to underproduction -- or perhaps making production utterly impossible.

Nonrivalrous consumption

Public goods and collective goods both have the quality of nonrivalrous consumption.

Paul Samuelson has defined a **public good** as a product

which all enjoy in common in the sense that each individual's consumption of that good leads to no subtraction from any other individual's consumption of that good [6].

Because the marginal cost of providing the public good is zero, the exclusion of any consumer would be inefficient. The only way to avoid excluding consumers, however, is to provide the good for free -- but no private company could afford to

do this. Therefore, private companies that provide public goods will do so in an inefficient manner; they will end up excluding people who could have enjoyed the good at no marginal cost to the owner or to the other customers [7].

THE LIBERAL RESPONSE

How then can market economists respond to the seemingly impossible barriers erected by the orthodox theory? Once again, let us take the different kinds of non-private goods in order.

Nonexcludability

The quality of nonexcludability shared by collective goods and common goods has been extensively analyzed by classical liberal economists. As they have discovered, the problem of exploitation of **common goods** can in many cases be solved simply by allowing exclusion; that is, privatization is often the solution to the tragedy of the commons. Frank Knight made this point in his critique of Pigou [8], and for the same reasons the political economists John Baden and Richard Stroup have also argued for privatization of state-run forests, parks, and other environmental assets [9]. Many liberal scholars argue that if common goods such as the continental shelf and inland waterways were private property, then owners would have a strong pecuniary incentive to prevent overexploitation by using their right of exclusion.

The quality of nonexcludability in **collective goods**, however, is somewhat harder to deal with. Privatizing a fishing stream may be fairly easy, but privatizing a collective good like national defence may be impossible -- how could the private operator of national defence services go about excluding nonpayers?

Even this kind of problem, however, is susceptible of market-oriented solutions. After all, Americans voluntarily subscribe to the Public Broadcasting System (PBS), even though anyone with a television can receive it. And people in the UK contribute to causes such as the National Trust which aims to preserve important landscapes for the whole nation.

Looking at the subject more generally, Earl Brubaker suggests that a contractual solution can be devised [10] for most examples. He argues that private providers of collective goods could use 'pre-contract exclusion' to force individuals in a community to contribute to such projects. Collective-good providers would simply present the community with an ultimatum: either contribute and/or contractually pledge enough money to fund the collective good or it will not be provided. Brubaker believes that a sufficiency of individuals in the community, faced with such an ultimatum, would give up their free-riding tendencies and pledge money in support of collective projects [11].

Nonrivalrous consumption

Paul Samuelson's contention that nonrivalrous consumption will necessarily lead to market failure has also been sharply criticized. Harold Demsetz effectively refutes Samuelson's position in *The Private Production of Public Goods* [12]. Demsetz argues that if the exclusion of nonpayers is possible, **public goods** can be provided efficiently by the market. In fact, companies already provide public or near-public goods, such as airline travel and theatres, through the use of price discrimination: consumers are charged different prices for the same good according to their valuations of the good [13]. In this manner, the inefficient exclusion of consumers can be prevented. As Demsetz notes, Samuelson and other adherents to the market-failure approach come to erroneous conclusions regarding public goods because they assume a unified pricing scheme.

Conclusion

All types of environmental problems may be classified under one of these three categories of market failure.

Air and water pollution are clearly problems of the commons: lakes, streams, the ocean, and the atmosphere are all unowned resources that are exploited due to their commons status. Wildlife conservation has the qualities of a collective good: exclusion of nonpayers is often a problem, and enjoyment of the animals themselves is nonrivalrous (unless, of course, one happens to be hunting them). Finally, parks and nature preserves may be public goods: sizable numbers of people can be accommodated without contributing substantially to overall costs, nor interfering much with the enjoyment of others, and exclusion of nonpayers is possible (though sometimes difficult, especially if the perimeter of the park is long and easily accessible).

Thus, environmental problems, as instances of market failure, are in principle susceptible to the types of market solutions described above.

Second, the phenomenon of government failure is often overlooked by market-failure theorists. Government action carries costs of its own, costs that may outweigh any possible benefits of intervention. Additionally, political actors (politicians, bureaucrats, and voters) may operate under undesirable incentives that promote rather than alleviate inefficiency. Special-interest lobbying, information problems, short political time horizons, inefficient bureaucracies, and political expediency - all these real-world factors guarantee a political structure unlike the relatively frictionless machine pictured by some orthodox market-failure theorists [1].

Market environmentalism capitalizes on these two insights. Its approach is market-oriented and skeptical of hasty calls for government intervention. Market environmentalism offers a comparative-systems approach, in which the incentives facing actors under different institutional arrangements are compared

3. MARKET AND NON-MARKET ENVIRONMENTAL POLICY

"Freedom of men under government is to have a standing rule to live by, common to every one of that society, and made by the legislative power erected in it, a liberty to follow my own will in all things where that rule prescribes not, and not to be subject to the inconstant, uncertain, unknown, arbitrary will of another man."

John Locke

Market environmentalism and market failure

We have just briefly examined orthodox approaches to market failure as well as some of the criticisms of these approaches. Among the many criticisms of orthodox theory, two points are especially relevant to understanding market environmentalism.

First, many of the critics of the orthodox approach have pointed out that the pursuit of profit is not the true culprit. Rather it is the **institutional arrangements and incentives** faced by self-interested market (and political) actors which are flawed. Rights to private property, so often labelled as part of the market-failure problem, are in fact part of the solution. Ironically, market failure often occurs where the state prevents a fully developed market system, based on private property rights, from arising.

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according to efficiency criteria [2]. Hence, government failure, as well as market failure, can be taken into account.

CURRENT ENVIRONMENTAL POLICY: COMMAND AND CONTROL

Let us begin, however, by looking at the principles and practices of current environmental policy, so that the different approach of market environmentalism can be more clearly contrasted.

Principles and cost

Environmental policy in industrialized nations is dominated by the 'command-and-control' approach.

However, this approach has been quite costly. As David Pearce and his co-authors Anil Markandya and Edward Barbier have pointed out, environmental regulations have led to noticeable reductions in gross national product (GNP) for most OECD countries [3].

Many environmental reform proposals, if implemented, could have even more significant effects on economic growth. For instance, a study done by American economists Alan Manne and Richard Richels shows that the annual costs of a proposed 20% reduction in US carbon dioxide emissions could approach 5% of GNP; though Harvard professor Henry Lee calculates that the costs might be twice as high as Manne and Richels' estimate [4].

Environmental control in the UK

Despite these daunting price tags, public worries over environmental problems have invariably been met with increases in governmental powers. Already in the United Kingdom, these powers are large and are wielded by an impressive apparatus of environmental control, as Dr Barry Bracewell-Milnes has catalogued [5].

Direct intervention in environment comes through the Town and Country Planning Acts; the Department of the Environment is involved in land-use planning, conservation and recreational use of the countryside, ancient monuments, sewage and water, pollution and housing; local authorities are especially involved with the provision of paths and bridleways, transport planning, tourism, national parks, listed buildings, derelict land, and structural planning. Then there are bodies such as the Forestry Commission and the Countryside Commission, which have more specific roles in the management of environmental assets.

Indirect intervention through the distortion of market pricing, says Dr Bracewell-Milnes, comes in policies like the Common Agricultural Policy, which provides an incentive for prairie-style farming, grants for grubbing up orchards, fertilizer subsidies (which contribute to rising phosphate levels in streams and rivers), and so on. There is so much of this price distortion, he argues, that 'it is not possible to make a list' [6].

Environmental control in the United States

Top-down, bureaucratic management has been the norm in the US government's environmental programme, which is perhaps more systematic than anything practised in the UK up to now, and which has generally taken three forms: direct ownership of land, intensive regulation of common goods, and clean-up efforts at waste sites. A look at the practical features of the US approach to environmental policy is therefore quite instructive.

(1) Nationalization of land assets

In the United Kingdom, comparatively little of the countryside is owned by the government, except for Military Purposes. The US experience, says Bracewell-Milnes, suggests that the UK is fortunate [7], in that the US government owns over 31% of the US land mass -- nearly 720 million acres [8]. Three agencies of the US government control the majority of this land: the Forest Service, the Bureau of Land Management, and the Wilderness Preservation System [9].

The **Forest Service**, founded in 1905 under the leadership of President Theodore Roosevelt, was one of the first agencies established by the US government to deal with environmental concerns [10], but has been criticized recently for its management practices. As John Baden and Richard Stroup have pointed out, these include selecting areas for timber extraction on the basis of political considerations rather than site productivity, using accounting practices that distort and inflate reported returns on investments, and 'maximizing the volume of extractions from a site rather than seeking the efficiency potential of that site' [11].

Despite the enormous timber assets contained in the Forest Service it ran a deficit of \$2.1 billion from 1975 to 1984 [12]. Below-market rates for lumber leases and the extensive construction of forestry roads for the use of private timber companies produce these deficits, which have to be made up through government subsidies. Public management of national forests may be emotionally appealing, but the quality of such management leaves much to be desired [13].

The **Bureau of Land Management**, created in 1946, has permanent jurisdiction over 270 million acres of land. Most of it lies in the western United States and is used predominantly for grazing purposes by private cattlemen [14].

As Doug Bandow notes, the BLM, like the Forest Service, is a poor manager of government lands:

The BLM estimates that 83% of the federal range is in 'less than satisfactory' condition and figures that its property will continue to deteriorate, losing as much as a quarter of its productive capacity in the years ahead. This should come as no surprise. The government runs its rangeland as it does its parks -- charging extremely low fees. Much of the federal land is leased at \$1.35 per month per animal (for grazing), even though a recent government study estimates the average market rate to be between \$6.53 and \$6.87 . . . [15].

With the BLM's below-market rates, ranchers have an incentive to overgraze, a classic tragedy of the commons [16]. The BLM has also adopted the controversial 'rest-rotation grazing' method, which can produce ecologically damaging results [17].

(2) Commons regulations

America's air and water are the victims of extensive exploitation because of their commons status. These resources are legally owned in common by 'the people': yet as Garrett Hardin pointed out, that which is owned by everyone is in fact owned by no one, and will be abused and eventually ruined. In an effort to prevent this tragedy from unfolding, the US government has passed statutes limiting discharges and ordering the use of specific antipollution techniques.

The point-source discharge regulations are used extensively for controlling air and water quality. They place specific limits on the pollution outputs of particular factories. Both the Clean Air Act of 1970 (updated 1991) and the 1972 amendments to the Federal Water Pollution Control Act of 1948 (FWPCA) use this regulatory structure [18].

Needless to say, the administrative process of determining effluent output for individual polluters is extremely expensive. For example, since 1970 the United States has spent \$225 billion to restrict air pollution through 'command and control' mechanisms [19]. As Paul Portney has noted, 'traditional air quality regulation may be, on average, about three or four times more expensive than the most cost-effective approach' [20]. Moreover, the administrative decisions of the Environmental Protection Agency (EPA) are open to court challenge, and polluters often find litigation to be in their best interest [21]. As Lloyd Orr notes in regard to the FWPCA amendments of 1972, issuing permits to over 60,000 point sources of water pollution is an administrative nightmare [22].

A further problem with many of these point-source discharge regulations is that they demand the use of particular antipollution technologies. The FWPCA amendments of 1972, for instance, mandate the use of specific technologies [23], as does the Clean Air Act [24]. But, as Lloyd Orr argues, progress in clean-up technology then comes to a halt [25] because no one has an incentive to do research to provide new kinds of antipollution devices. And even if such innovative devices were developed, why would any factory manager introduce them? The Environmental Protection Agency might then declare the newly adopted technology as 'standard' and force it on all the manager's plants -- according to an EPA schedule, of course. Thus, discharge regulations, like national land-management programmes, are undermined by the ill-conceived (and costly) incentive structures which they put in place.

(3) Clean-up programmes for toxic wastes

In addition to national land management and common usage regulations, the US government also takes an active role in cleaning up toxic waste sites. Foremost among its initiatives is a programme known as Superfund. This programme, begun in 1980, created a \$1.6 billion fund to clean up sites on a national priority list devised by the EPA [26].

The Superfund programme, like the environmental programmes discussed above, is plagued by problems [27]. By 1986, work had begun at only 132 of the initially designated 851 sites, and had been completed on six. There are now over 1,200 Superfund sites, and even by the EPA's conservative estimates, the number could reach 2,000 by the end of the decade. Some government sources think that the actual number of sites that might qualify could exceed 30,000. With an average cost of cleanup of \$25 million per site, and with some costing much more, a Congressional report noted that hazardous waste cleanup could be a 30-60 year, \$500 billion programme. Nevertheless, after ten years of operations and billions of dollars of expenditure, only 65 sites have been completely cleaned up today [28].

Doug Bandow describes some of the other problems involved with the Superfund legislation:

The Superfund legislation, by expanding liability beyond the traditional grounds of fault and causation, actually has hindered efforts to get private parties to clean up waste dumps . . . Moreover, chemical firms and dump operators are finding it difficult to get insurance coverage, which would fund cleanup efforts, because of the unjustifiably broad liability provisions. The revenue mechanism, a special tax on the petrochemical and oil industries, gives culpable parties no incentive to be more careful [29].

Liability is difficult to assign when the vast majority of sites are multiparty sites, and when records of old waste disposals are often incomplete. So the EPA names

'potentially responsible parties' as liable. They of course turn to their insurers to meet this liability, though the insurers are reluctant to pick up an open ended bill for cleanup unless their own liability is clear, so cases often end up in court. Businesses of all sizes, government bodies, individuals and voluntary organizations, have all found themselves drawn into protracted and expensive litigation about who should pay for the cleanup -- instead of everyone actually getting on with the job [30].

Many business leaders are certain that the Superfund system must be changed, and have proposed replacing the liability system with a new trust fund that would raise cash for waste cleanup regardless of liability. Even so, the Superfund programme will no doubt continue through sheer inertia, though its contribution to solving the long-term problem of toxic waste disposal has been anything but clear. On the bright side, however, other countries are certainly learning from the EPA's apparent inability to impose retroactive liability on polluters.

Bureaucratic management

One thread that seems to tie together three types of environmental programmes is bureaucratic management. In all cases, the US Congress or the UK Parliament has merely passed rough guidelines, giving broad powers to fill in the details to local authorities or to specially created agencies such as the EPA and the Forestry Commission. The result has been bureaucratic environmental management, a system particularly vulnerable to government failure.

THE MARKET ALTERNATIVE

Market environmentalism offers a fresh approach to our most pressing environmental problems [31]. Current policy has been crippled by an undue reliance on intricate, top-down regulatory structures and bureaucratic enforcement mechanisms. Market environmentalism suggests a new path: greater reliance on the marketplace to provide environmental amenities in an efficient and decentralized manner.

Incentives and information costs

Economists Terry Anderson and Donald Leal have defined two basic tenets of the approach [32]. The first is that **incentives matter to all human behaviour** [33]. This tenet forms the core of public-choice theory: both economic and political actors are influenced, for better or for worse, by the incentives they face. The second central tenet is that **information costs are positive in both the private and public sectors** [34]. Information regarding the social valuation of resources is costly to obtain in any institutional setting. Obtaining it in a bureaucracy involves special costs of its own, however, because

state management dispenses with, or at the very least distorts, the price system. Market pricing allows individuals to gauge the opportunity costs of their actions; without this system, estimating such costs usually degenerates into sophisticated guesswork.

In summary, market environmentalism urges us to pay 'careful attention to information and incentives faced by actors under alternative institutional arrangements' [35]. The high cost of information in bureaucratic settings and the socially harmful incentives that political actors face both suggest that markets may be preferable institutions in many situations

On the practical level, the market solutions for environmental problems which can be drawn from these basic tenets tend to fall into one of four categories: recognizing and correcting perverse incentives, privatization, market-oriented regulation, and liability. Let us consider these strategies in turn.

Perverse incentives

Tax rules, grants, subsidies, and regulations, however well-intentioned, often have undesirable and even disastrous consequences; and innumerable examples abound.

Rates. For example, local-authority rates were once levied only on occupied property. But it was then felt that all habitable property should be rated, which would be easier administratively, would raise more revenue, and would encourage property owners to let their property, rather than leave it empty.

The decaying consequences of this policy are all around. Faced with rates bills they could not afford, owners of country houses both grand and plain removed the roofing tiles (making the property uninhabitable) rather than pay the tax. Elegant houses dating from the nineteenth, eighteenth, or even earlier centuries were soon lost as wind and water rotted their internal structure. And, of course, death duties (or inheritance tax) although equally well-intentioned, simply added to the speed at which owners destroyed the property they could not afford to pay tax on.

Agriculture. Agriculture policies in Europe, although originally intended to help small-scale farmers, have instead changed the appearance of the UK countryside in undesirable ways, as already mentioned. Anxious to squeeze the last ounce of crop from their land, farmers have employed much more intensive farming methods until parts of East Anglia resemble the Midwestern United States. Hedgerows (and the wildlife inhabiting them) have been removed to allow larger machinery to work without interruption. Pesticides have raised crop yields but threatened butterflies and other wildlife. Herbicides have killed weeds, but endangered many familiar wild flowers as well, as has the draining of water meadows. Assistance for hill farmers has caused them to sow wheat on previously wild and unspoilt land that was appreciated for its wildness.

Subsidies for particular crops and processes has turned the June countryside bright yellow as farmers plant oilseed rape for cattle feed -- not just an unsightly crop, but one now being blamed for rises in hay fever and other allergies. Intensive agriculture has exhausted the land, leading farmers to use more and more fertilizers -- again long encouraged by subsidies -- which have gradually leached into streams and waterways, causing them to become choked with rapidly-growing weeds and algae.

Transport pricing. In urban areas as well, bad policy has produced bad environments. Subsidized urban transport makes city centres more densely populated than they would otherwise be. Peak-hour pricing of trains and buses has been rare because the decision is more of a political one than a commercial one. And roads become clogged at peak hours because there is no peak-hour price incentive mechanism to induce people to spread their journeys throughout the day and night [36].

Urban housing. Poorly designed local authority housing estates are another problem. Open land and access might have appealed to the social aspirations of the 1960s designers, but now we know that people protect and preserve a garden far better if it is enclosed so that it is clearly 'theirs'. Estates owned by some distant authority are as good as owned by nobody; no resident can take responsibility, nor do they regard routine maintenance and general security as properly their task. Indeed, they have every incentive not to interfere, even when they see vandalism is being done; and so graffiti, litter, damage; and worse problems emerge. Yet simple design changes can alter the incentive structure so that people begin to take a more personal interest in their living environment [37].

Planning imbalances. Land-use planning policy has a number of systematic imbalances that may not generate the best overall outcome. For example, decisions about new development are taken, in the first instance, by local authorities, which may be very concerned about the impact on their own communities, but not concerned about any wider benefits that might occur to others: the 'nimby' (not in my backyard) and 'nimpoo' (not in my period of office) syndromes. Some of these decisions go up to the Secretary of State for the Environment, but even then there is little objectivity in the outcome because for political reasons the Secretary of State is usually reluctant to override local interests. Such political restrictions on the use of land for development serve visible interests well; but there are many invisible victims who are not accounted. Thus urban housing becomes increasingly expensive, dwellings become smaller, and shops more crowded. Again, some more objective and broader-view planning process could bring superior overall results, if one could be constructed [38].

In all of these cases, the first step must be to recognize the systematically perverse nature of the incentives; then perhaps it will be possible to find ways of realigning them.

Privatization of unowned resources

The first solution suggested by market environmentalism is the privatization of government-owned land and commons areas. National forests and wilderness areas could be turned over to new private owners, such as preservation groups, which would be given all the benefits (and responsibilities) of ownership. Property rights could also be established in underground water supplies [39]. Some people have even suggested the possibility of selling property rights in the continental shelf [40].

While on the surface this might seem like consigning precious environmental resources into uncertain hands, the opposite is in fact the case. As Barry Bracewell-Milnes points out, the UK countryside which we admire so much 'is mostly the work of man'. As he explains,

Most of the surface is covered by man-made forests, farms, villages, country lanes and gardens. Some of the most admired large parks are attempts to improve on nature by landscape gardeners like Capability Brown.

The countryside whose defence from present-day threats and attacks is a matter of so much concern to well-meaning people is primarily the work of individual economic agents pursuing their business and other economic interests without government direction or control [41].

In urban areas too, the most admired townscapes are invariably those produced by private, and not by public, planners. The charm of mediaeval city centres, the grace of the great cathedrals and churches, and the parks and great town houses invariably owe their creation to private construction and design. Bath or Edinburgh show the sheer scale on which private builders, often building purely speculatively within very general overall planning guidelines, can create a harmonious elegant, but interesting townscape. This has *not* been a normal consequence of state planning and construction of towns (eg Milton Keynes) or housing estates (eg Chalk Farm). For all these reasons, privatization of land and buildings could well be a step in the right direction.

Although privatization is not technologically feasible for certain commons resources (the air, for instance), it does provide the possibility for market reform in a wide array of cases. Privatization, by more closely tying authority over natural resources to responsibility, would guarantee their wiser use. As Jo Ann Kwong puts the matter:

When property rights are specified to be exclusive, all rewards and penalties resulting from an action accrue directly to the owner. In other words, individuals face the full opportunity costs of their actions [42].

Thanks to the 'feedback' of profits and losses, private property rights can provide persuasive incentives for owners to shift their resources to the most highly valued uses -- a vast improvement, to say the least, over bureaucratic management.

Regulation by general rules

When privatization is technologically (or perhaps politically) infeasible, market-oriented regulation is an alternative. But what distinguishes such regulation from the 'command and control' variety that now dominates environmental policy?

Current policy mandates specific output levels for individual polluters and is based on administrative fiat. The result is little technological innovation in pollution control, high costs, and uncertainty. Market-oriented regulations, on the other hand, would replace complex edicts; they would set out clear, certain rules that encourage diversity and innovation.

Market-oriented regulations can take several forms [43]. The most widely-discussed market solution is that of **effluent charges**. Polluting industries would be charged a per-unit tax on their output of effluents into the water and air. Ideally, this tax would be set at a level that would lead polluters to take into account the social costs of their polluting activities [44]. Under the effluent-charge system, the negative externality of pollution would be 'internalized', leading to a reduction in pollution to a socially optimal level [45]. Some countries are already gravitating to solutions of this sort [46].

Marketable pollution permits are another market-oriented regulation, one which is already operating experimentally in the United States, and on which the UK government is presently funding research. Under this system, the government or local government determines the socially optimal level of pollution. This pollution level is segmented into a number of blocks, or permits, which are auctioned off and give holders the right to pollute up to that limit (but no more). These permits would be tradeable by their owners; so this system, like the effluent-charge mechanism, would provide substantial incentives for innovation, because firms which adopted advanced antipollution technologies would be able to reduce their effluent charges and save money by selling off their pollution rights [47].

Another possible market reform would be **market pricing of government services**. As noted, governments often charge below-market rates for commercial and recreational use of public lands and other facilities. By charging higher rates, problems of overuse and exploitation could be overcome and substantial revenues generated.

Liability provisions

When neither privatization nor market-oriented regulation is applicable, **liability** remains an option. Some forms of pollution (toxic wastes, oil spills [48], etc) are simply not susceptible to the methods described above. The only market mechanism for preventing these disasters is the 'polluter pays' principle. This principle, simply put, is that 'parties responsible for polluting the environment should also be responsible for cleaning up the pollution they cause' [49]. Superfund shows the problems of applying this principle retrospectively; but for the future, making companies liable for pollution would lead to greater caution in their operations and to the precautionary purchase of insurance, which, in case of an accident, would help pay for clean-up efforts [50], and which would induce firms to improve their antipollution security in order to qualify for lower premium rates. Like privatization, the liability mechanism would force people to be responsible for the consequences of their actions and would therefore reduce the chances of environmental disasters like the Exxon Valdez incident.

COMPARING THE TWO APPROACHES

Current environmental policy and the alternative offered by market environmentalism can be compared on several grounds.

The first area of comparison involves the distinction between **rules and commands**. Which of the two environmental policy systems is better equipped to harness the decentralized knowledge that exists among economic agents and provide incentives for innovation and discovery? The second is the question of **intergenerational equity**. Which system best conserves resources for future generations, who presently have no voice in either the marketplace or the government? The third is the issue of **competition and governmental integrity**. Which environmental policy best promotes competition and best prevents powerful groups from using political mechanisms to further their own ends? The fourth and final area of comparison is that of **liberty and the rule of law**. Which system of environmental controls best promotes personal freedom, and certainty and due process in law?

(1) Commands vs rules in environmental policy

A helpful way to improve one's understanding of the continuing debate between the two environmental-policy camps is to examine the distinction between commands and rules [51]. An excellent discussion of this distinction can be found in T Alexander Smith's *Time and Public Policy* [52].

As Smith notes, **commands** require the performance of specific tasks by known persons in particular circumstances. Current environmental policy is clearly dominated by commands, so defined. For example, in the water policy described

above, specific polluters are ordered by administrative fiat to install particular antipollution devices to reduce output to prescribed levels.

But **rules** are substantively different. They are not specific and concrete, but general and abstract. They do not require individuals to act in definite and prescribed ways; they simply define the *limits* of individual action -- whoever that individual might be. For example, the effluent-charge system, though not a pure rule, roughly approximates one: it applies to a broad class of individuals (polluters), and it does not specify the adoption of particular effluent output levels nor particular antipollution technologies, but rather charges a flat rate per unit of effluent. Decisions concerning output levels and antipollution technology are left to polluters.

Even this rudimentary distinction reveals that commands, to be effective, require **much greater quantities of information** than do rules. If we are trying to bring order to an economy by specifying precisely who should do what and when, we inevitably find ourselves having to juggle an enormous number of factors and trying to match them one with another, even though all of them are constantly on the move. Central planners are only too well aware of the problems. On the other hand, the spontaneous order in the marketplace is brought about not by central commands, but by the mutual adjustment of millions of individual actions through the (rule-based) price system and social rules such as the laws of contract and property. Relying on general rules rather than specific commands allows the market economy to utilize very much more information, and much more widely dispersed information, than can be incorporated into the commands of central economic planners [53].

Current environmental policy, based on command-type regulations, is inefficient because it is incapable of collecting and using all the information necessary to manage the environment properly. The information requirements for centralized, bureaucratic management are immense, and we should therefore not be surprised that the results of such management to date have been less than satisfactory [54].

The reforms proposed by market environmentalism are more appropriate to the complexity of advanced economies. Effluent charges, liability, privatization -- all these reforms move us closer to a rules-based regime of environmental law; allowing millions of individuals to use whatever specific knowledge they possess to further their own ends, whatever those might be, within the imposed constraints of the law. In this way, information, both technical and organizational, that had been overridden by command-based regulations would be brought into play, and natural amenities could be delivered at a much smaller cost.

Yet command-based systems are handicapped in an even more fundamental way, for only through the process of market choice can information about **people's preferences** be revealed.

As the Austrian economists have argued, the preferences of individual consumers are completely subjective and incapable of being measured. Moreover, they change over time. Only in situations of actual choice are preferences revealed: only when people actually decide to exchange one thing (an amount of money, say) for another (such as an unspoiled view) are their true preferences revealed and only then can relative weights be assigned to them. Without a market pricing system, regulators simply cannot know what consumers want [55].

(2) Intergenerational equity

The question of intergenerational equity is often brought up in discussions of natural-resource use. Few economists will take issue with the assertion that, under certain circumstances, the market economy will effectively allocate resources among present consumers, who can register their preferences through the price system. Future consumers (the unborn), however, have no voice in the allocation of resources. Are we justified in exploiting exhaustible natural resources at the present rate, given the needs of future generations? Equity (one might say) is not just spatial, relating to present members of society, but is temporal as well, relating to future members.

Which system of environmental stewardship -- market or government -- will best preserve resources for the future? Many argue that only government can accomplish this end, because the market is short-sighted and takes account only of the preferences of present consumers [56]. Is this accusation valid?

An analysis on the issue of intergenerational equity and natural-resource use has been done by John Baden and Richard Stroup [47]. They start with a hypothetical example of an exhaustible natural resource -- a copper mine -- and then seek to determine which system of stewardship would lead to the greater conservation of the mine's copper [57].

First, consider the fate of the mine under the ownership of a democratic government. The decision of whether or not to use the mine's resources depends on the voters' perception of the future value of the copper as opposed to its present value. If the voters feel that the copper will be worth much more in the future, they will vote for conservation. If they feel that it is worth more now, they will vote for exploitation. The outcome will be based on speculation rather than hard fact, and because the majority rules in democratic systems, 'the median voter's judgment prevails' [58].

Baden and Stroup now examine the fate of the mine under private ownership. In the market economy, resources flow to the highest bidder. But this method of allocation guarantees a bias towards conservation:

Obviously, if anyone (with sufficient funds, or credit, or the ability to convince fellow risk takers) believes the mine will be sufficiently more valuable in the future use than now, so as to justify postponing

its use, the resource will be conserved or preserved. Unlike political decision making, the median opinion does not control decisions in the market. The tendency instead is for those with the strongest bias to preserve resources to control [59].

This conclusion is counterintuitive: for these people who are so keen on conservation are those whom we call speculators -- not usually looked on as public benefactors, and indeed operating out of self-interest. These private speculators are prepared to buy and hold resources, rather than exploit them now, in the hope that their value at some future point will more than compensate for the price they pay for the resources today. And it is the very keenest to conserve who will prevail -- since those who think the resources will be worth the most to future generations will be prepared to stake the most in order to hold them until that time.

This beneficial role of the speculator in conserving exhaustible natural resources suggests that the market may hold distinct advantages over the democratic political process in the area of environmental stewardship.

(3) Competition and governmental integrity

The present regime of environmental law, based primarily on commands and bureaucratic management, affects the structure of the markets that it regulates, and this effect is far from neutral.

Command-and-control regulations usually require or lead to restrictions on industrial output. Such restrictions, however, often serve the vested interests of the industry being regulated. As James Buchanan and Gordon Tullock have noted, to the extent that the restrictions work by the assignment of production quotas to existing firms, **new competitors cannot enter** because they have no production quota. It is just as if the old firms had formed a cartel to exclude newcomers [60]. That, of course, is highly advantageous to existing firms, and **raises profits**. So, not surprisingly, therefore, polluters will generally prefer command-and-control regulations to economic instruments like effluent charges.

But output restrictions, by raising profits in the affected industry, will attract more potential newcomers. So the administrators of such programmes 'must somehow prevent new entrants' [61]. A failure to do so would lead to pollution levels exceeding the government's goals. Thus, command-and-control regulations, in addition to raising industry profits, can also **hamper competition** by restricting the entry of new firms into the industry.

Command-and-control regulations may also **increase the size of firms** already in an industry. Economies of scale often exist in complying with such regulations; that is, large concerns will have cost advantages over smaller competitors in compliance. And empirical work shows that environmental

regulations have reduced the number of plants and **increased concentration** in the industries with high pollution abatement costs [62].

Why then are command-based regulations, with their high costs and perverse effects on industrial structure, so dominant in current environmental policy? George Stigler, 1982 Nobel Laureate in economics, provides one possible explanation in his now famous essay *The Theory of Economic Regulation* [63]. As a rule, he argues, regulation is screened by the industry; every industry that has enough political power will seek state regulations to control entry, and will ensure that those regulations are designed and operated for its own benefit.

Some regulatory agencies may well have been created with the public interest in mind. But over time, even they develop policy positions remarkably consonant with those of the larger enterprises they regulate. Such 'capture' of regulatory agencies can arise in several ways. Outright bribes are possible, though probably rare. The 'revolving door' principle -- the ability of ex-bureaucrats to get jobs in the industries they once regulated -- also provides a strong incentive for bureaucrats to toe the line of big business. Also, the bureaucrats who run the agencies must have considerable knowledge of the industry they are regulating; hence, agency employees are often drawn from the ranks of the regulated. Finally, the industry itself will be the main source of the information which the information the agency receives, making objective judgments about the costs and benefits of certain regulations impossible.

Of course, these industrial regulations may impose expensive burdens on big business, and the political process which decides them is quite costly to manipulate as well. But by working through the state, large enterprises can legally block entry into industries and can force out smaller competitors, thus gaining more secure profits. This rationale may partly explain why businesses have often been resistant to changes in environmental law: the present law may be burdensome, but it also reduces competition and leads to industrial stability. As Maloney and McCormick point out, environmental quality regulation is complicated, but many of the observed perplexities are consistent with rent-seeking and self-interest [64]. Rules-based policies may be less costly and more efficient, but they would undermine present entry and operational restrictions which the larger enterprises would not welcome [65].

(4) Rules, commands, and liberty

The final mode of comparison between command-based and rules-based approaches to environmental policy is the fate of individual liberty under the respective systems.

Individual liberty and the rule of law are inextricably connected. Since medieval times, the rule of law has been considered a cornerstone of personal freedom. That means that the law must be certain: a man ruled by commands which can be changed at the mere whim of a ruler is not free at all, but a slave to the

passions of another. Secondly, the law must apply to all men equally and in a variety of circumstances; special privilege is arbitrary and a threat to freedom. Finally, the law must consist of general prohibitions, not specific commands; a law that details the actions that subjects must take compromises their liberty and prevents them from peacefully pursuing their own objectives. In short, liberty is nothing but freedom of action under a known and equally applied rule of law [65].

Clearly, the rule of law is a legal structure dominated by rules, not commands. Commands violate the rule of law precepts of certainty, equality, generality, and negativity; and for this reason, current environmental policy violates individual freedom. It subjects individuals to the discretionary authority of distant, centralized bureaucracies that issue direct commands, that treat citizens arbitrarily and unequally, and that change policies regularly.

A rules-based environmental policy, in addition to being more efficient and equitable than the alternative, is more respectful of individual freedom. Under rules-based regulations, individual citizens are allowed to pursue their own aims freely, constrained only by laws that apply equally to all and that are not subject to capricious revision by the powers that be. Only the rules-based environmental policy encapsulated in market environmentalism is consonant with the protection of individual liberty.

THE LIMITS OF MARKET ENVIRONMENTALISM

Market environmentalism is an innovative theoretical structure that offers novel solutions to a wide range of environmental problems. Like all theoretical structures, however, it has its limits.

Property rights

Thus the market environmentalist policy prescription of privatization is subject to a number of provisos, both theoretical and practical. Economists William Baumol and Wallace Oates doubt that privatization or contractual solutions will work except in cases where small numbers of individuals are involved [67].

For example, privatizing certain commons areas (such as the atmosphere) would be difficult. Privatization is an effective solution only if the costs of enforcing property rights are not prohibitive. The technology for enforcing air rights is not currently available, and even if it became available the cost of its usage for individual owners might outweigh its benefits. Creating property rights in the atmosphere without efficient enforcement mechanisms would not alter their commons status; unauthorized users would continue to discharge their pollutants into the atmospheric property surreptitiously.

Another problem concerns public expectations. The atmosphere, the ocean, streams, lakes, wilderness areas, etc, are regarded by the public as free goods, much like sunshine. The fact that these commons resources are in fact not free goods, but are scarce economic goods, does not seem to impinge upon the public mind. Privatization will be successful only if the public comes to realize that the commons status of these resources is the *cause* of their exploitation and to accept that present policies of unlimited access to such resources must be changed.

IMPLICATIONS FOR POLICY

Rules-oriented regulations

Rules-oriented regulations offer an alternative to privatization when property-rights enforcement mechanisms are not available or are too expensive. Like privatization, however, the policy-rules alternative has its limits.

Rules-based regulations can also run into enforcement problems. Designing effluent charges and marketable pollution permits for point-source discharges may be fairly inexpensive: the source of the pollution is known, and metering or other methods of measuring effluent output can be used successfully. The existence of non-point-source discharges creates special enforcement problems, however. Using rules-based regulations for agricultural pollution (such as nitrates leaching into waterways), for instance, may be quite difficult, since there are often no explicit sources of effluent output that can be identified and measured.

The same problem arises in relation to certain types of atmospheric pollution. How can one set up a system of pollution permits for users of aerosol cans that produce damaging chlorofluorocarbons (CFCs)? The enforcement costs of such a scheme would be prohibitive. In such situations, the only solution may be outright bans on some products.

Another problem with rules-based regulations is the difficulty of international cooperation. As indicated above, marketable pollution permits for point-source discharges could work easily within a town or a country. For environmental problems of international scope (such as ozone depletion or acid rain), however, implementing such rules-based regulations would require the cooperation of sovereign national governments on an unprecedented scale. Whether national rivalries will prevent market-oriented solutions from arising is a matter of speculation, but such political obstructions are a real difficulty.

Finally, these rules-oriented regulations are often hindered by information constraints. Both effluent charges and marketable emission permits require the government to determine the social costs of pollution. This may be difficult or impossible to establish.

These weaknesses of market environmentalism must, of course, be viewed in the context of alternative approaches. Those situations where the approach fails are usually situations where command-and-control policies run into trouble as well.

Problems of enforcement and international cooperation are by no means unique to a market-oriented environmental policy; they are problems that must be addressed under any pollution-abatement paradigm. Similarly, information constraints are just as problematic for command-and-control regimes as they are for rules-oriented alternatives [68].

IMPLICATIONS FOR POLICY

The rules-based approach of market environmentalism holds clear advantages over the command-based approach of current environmental policy. Current policy is handicapped by its inability to harness decentralized information, provide adequate incentives for conservation, promote competition, prevent governmental corruption, and preserve personal freedom and the rule of law. On each of these fronts, market environmentalism offers a superior alternative. Efficiency, equity, and liberty would all be better served under a rules-based system of environmental law.

Theoretically, free-market environmentalism presents a powerful tool for analysis. But can it be applied successfully to real environmental crises? The next chapter examines this question. Private property and rules-oriented solutions -- both hypothetical and actual -- will be compared. And we will see that, in sharp contrast to the mediocre performance of present environmental policy, market environmentalism offers real hope of improving environmental quality through the extension, rather than the abrogation, of the market system [69].

Fee-controlled hunting

Wildlife in America is theoretically owned by the state governments, and in the United Kingdom it is protected by the national government. To protect wild animals from the tragedy of the commons, such governments have taken actions such as limiting hunting through licensing, restocking wildlife, and forbidding or curtailing the sale of wild game [2].

In addition to these government actions, however, a recent private initiative has promoted animal conservation -- fee hunting. Although private landowners may not actually be able to own the wild game on their premises, they can improve the habitat for the animals (thereby increasing their numbers) and then charge hunters who want to stalk and kill the game [3]. The fact that the animals are available and valued for sport means, paradoxically, that they are more effectively protected and conserved by private wildlife managers than they would be if a ban on hunting made them of value to no one.

4. MARKET ENVIRONMENTALISM IN PRACTICE

"Resources held as part of a decision maker's wealth will seldom be squandered."

Richard Stroup and John Baden

WILDLIFE CONSERVATION

The dwindling populations of some wildlife and the extinction of a growing number of species (10,000 per year in tropical forests alone [1]), have caused great concern among environmentalists. 'Greedy' hunters and poachers are usually blamed, but, as the analysis of the past two chapters has suggested, this reaction fails to take into account general structures of incentives. Wild animals are unowned (though they may theoretically be owned by 'the people'), and so no one has an incentive to conserve them -- another tragedy of the commons.

Even in the absence of any legal recognition of the private ownership of wildlife, however, many innovative private solutions have been developed to maintain and preserve wildlife through the development of property rights under market principles.

Fee-controlled hunting

Wildlife in America is theoretically owned by the state governments, and in the United Kingdom it is protected by the national government. To protect wild animals from the tragedy of the commons, such governments have taken actions such as limiting hunting through licensing, restocking wildlife, and forbidding or curbing the sale of wild game [2].

In addition to these government actions, however, a recent private initiative has promoted animal conservation -- fee-hunting. Although private landowners may not actually be able to own the wild game on their premises, they can improve the habitat for the animals (thereby increasing their numbers) and then charge hunters who want to stalk and kill the game [3]. The fact that the animals are available and valued for sport means, paradoxically, that they are more effectively protected and conserved by private wildlife managers than they would be if a ban on hunting made them of value to no one.

Terry Anderson and Donald Leal have researched the growing market for fee-hunting [4]. As the demand for recreational activities such as hunting has risen over the past few decades, private property owners have responded quickly by developing fee-hunting reserves. The inability to establish property rights in wildlife has hampered the market response, but has not prevented it.

An example of this market response is the wildlife programme of the International Paper Company. It has invested a considerable sum of money improving wildlife habitats on the 1.65 million acres it owns in the southeastern United States. Yet it improves these habitats not primarily for philanthropic reasons, but for the profits available in hunting fees. The company anticipates to be able to charge hunters fees up to \$10 per acre per day as the demand for the service increases [5].

Anderson and Leal note that this pattern of habitat improvement for fee-hunting has spread rapidly to smaller landowners. In Texas, where 85 percent of the land is private, hunting leases have become popular. Returns from deer hunting leases now exceed returns from livestock operations in some parts of the state [6]. Greyson Creek Meadows Recreation Inc, in Montana, is another example of private entrepreneurship providing better habitats for wildlife. The company leases 30,000 acres from local landowners for the use of a small club of local sportsmen, who each pay \$350 per year for the right to hunt on the land and to use it for other recreational purposes [7].

The concept of fee-hunting shows clearly how the 'invisible hand' of commerce can lead individuals to promote public ends that are no part of their intentions. Landowners ranging from large corporations to small ranchers have provided improved habitats for wildlife -- in pursuit of profit -- and without the slightest encouragement from the state.

Private preserves

Private initiative also provides natural amenities through the creation of private preserves. Literally millions of acres in the United States have been preserved through the efforts of private conservation groups, which seek to preserve the natural heritage for future generations.

The Nature Conservancy was founded in 1951 to find, protect, and maintain rare ecosystems and species. To date, it has protected over 3.5 million acres in the United States alone, and over 4 million acres of tropical rain forests. For funding, it relies heavily on the contributions of its 460,000 members and its 222 corporate associates [8]. The Nature Conservancy demonstrates the effectiveness of private action in preserving environmentally sensitive areas [9].

The Audubon Society, roughly equivalent to the UK's Royal Society for the Protection of Birds or the Wildfowl Trust, has also created numerous wildlife sanctuaries. The largest of these is the Rainey Wildlife Sanctuary in Vermillion

Parish, Louisiana. Covering 26,800 acres of marshland, it is a haven to tens of thousands of migrating snow geese as well as to other swamp creatures, such as mink and alligators. Following approaches from oil exploration companies whose surveys indicated sizeable reserves of oil under the site, the Society allowed three different companies to drill in the Rainey Sanctuary. Very strict controls were agreed on the locations and times of year when drilling could take place in order not to disturb the birds, particularly in their breeding season. In 1981 the Society was earning royalties of about \$1 million per year as a result, all of which could be applied towards its other conservation work. Contrary to what one might think, the relationship between the Audubon Society and the oil companies proved amicable, and Society management praised the companies for their cooperation and concern [10].

In the United Kingdom, the Royal Society for the Protection of Birds (RSPB), founded in 1889, buys and manages reserves where threatened species can be helped. There are currently 118 such reserves in the UK. For this work, the Society relies on subscriptions from its 885,000 members, donations, and legacies -- all of which allowed it to spend over £20 million to fund conservation projects in the typical year 1989-90. The Society produces wildlife films, books, and videos, and runs schemes to show wild birds to people on tourist sites [11].

The effectiveness of the RSPB, the Nature Conservancy, and the Audubon Society in preserving wildlife habitats casts doubt on the gloomy assumptions of public-goods theorists. Effective advertising and the discovery of consumer markets for wildlife preservation have contributed greatly to the resounding success of such private-sector efforts [12].

Private ownership: sea turtle farming

Another approach to wildlife preservation is the domestication and private ownership of animals. Naturally, this conservation method has been opposed by many environmental groups, which consider making profits from the sale of wild animals exploitative. As the analysis of the tragedy of the commons has shown, however, exploitation is most likely to occur if the species in question remain unowned.

One example of for-profit domestication was the Cayman Turtle Farm Ltd, on the Cayman Islands of the British West Indies [13]. Begun in 1968, the farm set out to breed the endangered sea turtle in captivity. Its stock of sea turtles rose to 80,000 -- over fifteen times the number that live in the wild in the western Caribbean and the Gulf of Mexico.

Many American environmentalists frowned on this business venture, despite its success in substantially increasing the green sea turtle population [14]. These environmentalists successfully lobbied for a ban on the importation of sea-turtle products in 1978. Unable to ship sea-turtle products to the United States or even to send them through Miami to other countries, the Cayman Turtle Farm

began to fail and was forced to sell out to the Cayman government, which now runs the farm on a vastly reduced scale as a tourist attraction [15]. The failure of the Cayman Turtle Farm in its large-scale commercial form no doubt made certain groups of environmentalists feel better, but one wonders if the failure of the farm was really in the best interest of the species itself.

PREVENTING POLLUTION

Another area of great environmental concern is the problem of pollution in the commons. As seen earlier, pollution occurs at an undesirably high level in the commons because polluters do not bear the full costs of their polluting activities. Different ways of solving this problem have been discussed: private ownership of common goods, effluent charges, and liability. The first two methods have been put to limited use and a few cases are worth examination.

Privatizing the commons: fishing streams

In Britain the right to fish a particular part of a stream or lake is a private right that can be bought, sold, or leased [16]. These rights are owned by individuals, fishing clubs, large corporations, and others. The owners of these fishing rights can and do charge people to fish; the fees usually vary with the quality of the fishing grounds and the species available to be fished.

This system of private ownership has many advantages over public ownership. First, the owners of the rights have an incentive to keep their fishing grounds well-stocked and clean to attract anglers. Secondly, private ownership and a fee system prevent overfishing and the resultant tragedy of the commons that arises so often in the streams and lakes of other countries. After all, nobody would pay to fish a stream that was empty of fish!

Finally, owners of fishing rights can take polluters to court. The Anglers Cooperative Association (ACA) was founded in 1948 to help the owners of fishing rights take legal action against polluters. The ACA has been extremely successful in its efforts to stop polluters; it has lost only one case since its first major suit in 1951. In fact polluters now usually settle out of court with fishing rights owners, compensating the owners for lost enjoyment and for the cost of restocking the damaged streams [17].

This system of private ownership, besides providing excellent fishing grounds, forces polluters to take into account the social costs of their actions. Fishing streams in Britain are relatively clean and clear (in comparison to those in other countries) due in large part to a strong system of private fishing rights; it may well be a system that can be transplanted to other countries worried about deteriorating water quality.

Emissions trading

The proposal by Baumol and Oates for issuing marketable pollution permits has in fact been used on a small scale in the United States [18].

The Environmental Protection Agency began using an emissions trading system in 1974 as an alternative means of implementing the 1970 Clean Air Act [19]. If any polluter reduces emissions to a degree higher than required by law, he can apply to have this excess control certified as an 'emission reduction credit' [20].

This credit can be used in several ways. The 'offset' policy allows holders of emission credits to sell them to newly established polluters or to polluters whose production processes would require prohibitively expensive antipollution devices. Thus overall air quality can be maintained in a manner consistent with continued economic growth. The offset policy is a rough approximation to a fully-fledged marketable pollution permit system [21].

A second way that emission credits can be used is with the 'bubble' policy. Firms are allowed to increase pollution at one of their sources so long as they match this by an equivalent decrease at another source under some geographical 'bubble'. As long as the total amount of pollution does not exceed mandated limits, businesses are free to rearrange source pollution any way they wish [22].

Finally, businesses may 'bank' their credits for later use in either the offset or the bubble policy [23].

These rules provide a measure of flexibility in the system. One would expect the adoption of such rule-based criteria to lead to improved cost-effectiveness, and indeed it does: according to Robert Hahn and Gordon Hester, the emissions trading system produced cost savings of nearly \$4.5 billion between 1974 and 1985 [24]. If such extremely restricted pollution-permit schemes can save enormous amounts of money, a full-fledged system of marketable pollution permits could provide a tremendous windfall without adversely affecting environmental quality [25].

Effluent charges

Europe has had some experience with water emissions charges. The oldest and best-known system is used for the Ruhr River basin in West Germany. The basin is a centre of intense industrial activity; in fact, 40 percent of West German industrial capacity is found there. As one would expect, the discharge into the Ruhr is tremendous. Indeed, as Baumol and Oates note, there are times when the volume of pollution exceeds the volume of new water entering the river [26]. Despite this heavy use of the Ruhr, however, its water quality remains extremely high. It continues to be used for fishing and recreation.

This high water quality is the result of a system of effluent charges that takes into account both the quality and quantity of emissions. Though not an ideal system from the economist's standpoint, the Ruhr system provides environmental protection at a lower cost than command-based alternatives [27]. In fact, studies have estimated the effluent charge policy to be about one-third cheaper for the polluters as a group than orthodox regulation [28].

Other countries have adopted effluent charges as well. The Netherlands and France, for instance, have systems of effluent charges for industrial and municipal sources of water pollution, though the charge is not based on marginal social-cost estimates, but on the costs of water-treatment programmes. In the UK, the National Rivers Authority maintains a scale of charges for consents to discharge into water, dependent on the scale of the discharge, the content of the discharge, and the type of water into which the discharges are made. Such licence fees range from just a few pounds to over £80,000 for a single consent. In an advance over the French and Dutch systems, there are longer-term proposals to impose extra charges, over the cost of cleanup and administration, as a means of imposing greater incentives on polluters to change their behaviour, and the government has commissioned research on such techniques. Early results from these effluent-charge experiments have been encouraging [29].

Effluent charges for air pollution

Throughout the 1960s and 1970s, Japan suffered from poor air quality. Sulphur dioxide (SO₂) emissions were severe enough to raise the incidence of many health problems, such as asthma. To rectify the air-pollution problem, Japan passed the Pollution-Related Health Damage Compensation Law in September 1974 [30].

The law employs an unusual mix of liability and effluent-charge measures, designed 'to facilitate settlement of damage compensation between the polluter and the victims on the basis of civil liability' [31]. Needless to say, determining liability in air-pollution cases is difficult. First, many diseases such as asthma cannot be blamed exclusively on air pollution. Second, even if they could be linked, how would one decide which polluter to hold responsible? Some areas may have dozens of factories releasing SO₂ into the atmosphere.

The 1974 law gets around these problems by a process of simplification. First, all polluters in an area are presumed guilty and are forced to pay levies proportional to their output of SO₂. These levies form a pool out of which compensation is paid. Second, any individual who meets certain criteria (eg, being from a heavily polluted region or having a specified disease) qualifies for compensation [32].

Although the system has helped relieve the suffering of certified victims of air pollution and has led to a drastic reduction in SO₂ emissions, it has been costly. Concern over the high costs of the compensation law led to its amendment in 1987. Under the new guidelines, prevention is emphasized over compensation.

Compensation payments continue, but only to victims already certified; Japanese officials no longer certify victims of air pollution.

Despite its present crudeness, this system offers an interesting twist on usual proposals for effluent charges. By using emission fees rather than direct controls, the Japanese have probably saved money, despite the considerable costs of their compensation system. By using these fees to help those injured by pollutants, they have also satisfied a basic requirement of justice -- forcing the wrongdoer to compensate his victim.

Fossil-fuels tax

Nicholas Ridley, when Secretary of State for the Environment, supported a fossil-fuels tax to curb the output of pollution [33]. He considered such rules-based environmental regulations to be perfectly consistent with his own brand of free-market thinking, and argued for an extension of the 'polluter pays' principle [34]. Unless we attach the costs of environmental protection to consumer goods, he explained, 'customers will not be getting the right signals to influence their consumption of the product which gives rise to the pollution'.

The same idea carried through to the government's 1990 white paper on environmental policy, which commented that 'markets often fail to take into account all the environmental costs and benefits. We need better analysis of these costs and benefits. We also need new ways of getting them reflected in prices' [35].

Through the 'pricing' of pollution, emissions can be reduced without the harmful side effects of direct regulation. First, expensive administrative mechanisms are not needed. Second, the tax can be adjusted to achieve optimal levels of pollution. Finally, because the levy is based solely on the amount of fossil fuels used, it preserves the incentives for innovation (eg, research for improving fuel efficiency). While a fossil-fuel tax is far from perfect, it points the way toward a rule-based environmental policy [35].

The United Kingdom has already instituted tax changes to reduce the use of leaded petrol in an effort to reduce airborne lead pollution, and the differential between the two types of fuel was increased further in the 1991 budget. At the same time, the tax and national insurance treatment of company cars have also been tightened in order to reduce their attractiveness. These changes are a modest step towards reducing car ownership and reducing carbon dioxide and other emissions.

The National Trust

In the UK, the National Trust now covers for well over half a million acres of some of the country's finest and most varied countryside, ranging from Scotland

Other emissions charges in Northern Europe

Other European and Scandinavian countries are using taxes, charges, and refundable deposits in order to induce people to curb their emissions or use different kinds of fuel [37].

Like the UK, Norway has a large differential favouring unleaded petrol. It also taxes CFC emissions and imposes a refundable deposit on used oil and batteries to prevent indiscriminate dumping. Its neighbour Sweden has extended VAT to energy, and levies tax on sulphur, nitrous oxide, and other emissions.

Finland, recognizing the potentially inflationary effects of new 'green' taxes (and some non-market interventions such as the banning of phosphate fertilizers), has made other adjustments to leave farmers' incomes unchanged. Charges on waste oil, drinks in non-deposit containers [38], and single-hulled oil tankers, have all been raised.

Germany is looking at proposals to tax cars on emissions rather than engine size. Italy has put new charges on plastics, herbicides, and non-biodegradable industrial waste. Landing charges for noisy aircraft have been increased.

Meanwhile, back in the United Kingdom, the drift towards market-mechanism incentives against pollution continues. The Institute for Public Policy Research has proposed a 25% rate of VAT on detergents containing phosphates, some batteries, energy inefficient appliances, and products containing CFCs; and a 0% rate on energy conservation and appliance repair services [39].

PARK SERVICES

Orthodox market-failure theorists usually consider park services, like wildlife conservation, as collective goods. They argue that to exclude nonpayers from public parks would be prohibitively expensive (points of entry are too numerous to police), so the market will underproduce, or perhaps even fail to produce, park services, and a government subsidy is therefore justified.

In fact, though, private and voluntary efforts have been quite successful in providing park services. Private parks have experienced little trouble excluding nonpayers. (As usual, the imaginations of entrepreneurs have proven superior to the imaginations of professional economists!) Even in areas where exclusion is not possible, successful park enterprises have been operated through charitable contributions and volunteer staffing.

The National Trust

In the UK, the National Trust now cares for well over half a million acres of some of the country's finest and most varied countryside, ranging from fenland

and moors to meadowland and woodland. Some 521 miles of coastline in southern England, Wales and Northern Ireland is also in Trust ownership.

The Trust allows free public access to much of this property, or makes a small charge for access to its 300 historic buildings and gardens. Schoolchildren and volunteers help maintain some of the freely accessible areas, while professional staff maintain other sites. The Trust lets nearly a quarter of a million acres to tenant farmers, and (by keeping farm units small and preserving walks and hedges) pursues a conservation policy even at the expense of lower rents and lost production [40]. Yet the Trust is a charity, independent of the government, and relying almost entirely on voluntary contributions -- about £40 million from members, £10 million from gifts, £16 million from renting out Trust properties, £22 million from investments, and £7 million from sales of souvenirs and other enterprises [41].

The National Trust for Scotland similarly cares for over 100 properties covering 100,000 acres in Scotland, including castles, gardens, historic sites, islands, countryside, coastline, and waterfalls -- all valued (for insurance purposes) at £142 million [42].

The Colorado trail

A good American example of a private park service in which no attempt has been made to exclude nonpayers is the Colorado Trail. A 470-mile hiking route in Colorado, the trail passes through seven national forests and six wilderness areas and transverses five major rivers. It provides many recreational and educational amenities to the general public.

The Colorado Trail was built and funded solely through the efforts of volunteers; no state or federal funds were used. For fifteen summers, beginning in 1973, volunteers spent their weekends and holidays building the trail. Since its completion, the trail has been maintained by volunteer crews and financed in part through an 'Adopt-a-Trail' maintenance programme, which provides food and equipment for the crews. The Colorado Trail is a remarkable volunteer achievement that shows the immense promise of non-government solutions to outdoor recreational needs.

North Maine Woods

Another example of the successful provision of private park services is North Maine Woods Inc, an association formed by twenty landowners [43]. North Maine Woods manages recreational activities on 2.8 million acres of mostly private commercial forests -- an area of land more than half the size of Wales -- and was formed in 1974 because of the problems which the growing demand for outdoor recreation was causing for the land owners. The unstructured recreational use of commercial forest land was producing soil erosion, litter,

overcrowding, and an increased probability of forest fires; the association sought to manage this public use and provide mechanisms for funding.

North Maine Woods controls entry into the park through 17 checkpoints and access roads. It registers campers and visitors and charges various user-fees, ranging from \$2 for a one-day pass to \$17 for a season permit [44]. The funds are used to control litter, build and improve campsites, and educate users about the use of the park. The efforts of the North Maine Woods association have produced a safer, cleaner area for recreational use without the slightest help from local government [45].

Other UK examples

There are, of course, plenty of other UK examples of where private companies have promoted conservation policies, either because they have found ways of making conservation commercially sound, or because they simply regard environmental protection as an integral part of their management responsibilities.

Dr Barry Bracewell-Milnes, in *Caring for the Countryside*, lists a number. The Economic Forestry group, for example, has planted new plantations to support a large population of wildlife, much in excess of what was there before and far greater than could be sustained by the layouts and tree species normally selected by the Forestry Commission. Such innovations are particularly important because trees are likely to be the main crop on land which is presently being taken out of agricultural production.

Ravenna Park: the dangers of political intervention

Ravenna Park in Seattle highlights both the possibilities of private park provision and the dangers of government management. Begun in 1887 by Mr and Mrs W W Beck, the park featured giant Douglas Firs, a concert pavillion, and paths and benches for walkers. The park charged user-fees of approximately \$3 (in today's prices) for one-day admission and \$60 for a year-long permit. Despite the fees, Ravenna was immensely popular; on busy days, between 8,000 and 10,000 people visited the park [46].

After lobbying by a number of Seattle residents who wanted an expansion of the public park system, Ravenna was compulsorily purchased by the city of Seattle in 1911 for \$135,663. Soon after the city's seizure of the park, the giant firs began to disappear: the park's new (city government) managers were cutting them down and selling them for short-term gain. Members of the public protested, but to no avail. By 1925 all the Douglas Firs had disappeared [47]. A park that had been run successfully by private efforts was ruined by government. The tragedy of Ravenna Park should give pause to environmental activists who see public stewardship as the answer to environmental problems.

5. POTENTIAL APPLICATIONS OF MARKET ENVIRONMENTALISM

"The problems will only be solved when the ideological heresies and fallacious representations are replaced by a sober assessment of the facts, in particular of the failure of so much government intervention and of the increasing success of private undertakings in shouldering responsibility for the environment."

Donald Denman

WILDLIFE CONSERVATION

Wildlife conservation has become an important issue for the environmental movement. Yet the debate over wildlife policy usually ignores the root of the problem, which is the lack of private-property rights in wild animals. As many market economists have noted, one never hears of cattle or dogs being on the verge of extinction. Extinction is not a threat for such animals precisely because they are privately owned. Their owners have a vested interest in keeping them alive and healthy for either productive purposes (cattle) or private pleasure (dogs).

Wild animals, however, are another matter entirely. Because they are a commons resource, no one has an incentive to conserve them. Exploitation and extinction are the inevitable fate of unowned animals unless use is somehow regulated. As we shall see, however, use regulations often have unintended consequences detrimental to the survival of the 'protected' animals. Private ownership is the only good solution in most cases, especially in the most celebrated ones. We shall examine two cases here: the whale and the elephant.

Saving the whale

International treaties have sought to prevent the slaughter of whales, but many of the largest whaling countries, such as Iceland, the Soviet Union and Japan, dispute or reject the legitimacy of the treaties. The situation is a classic example of the tragedy of the commons. Because the whales are an unowned resource, no one has an interest in conserving them [1]. Given that some nations refuse to respect or police the international restrictions, the future of many whale species remains uncertain -- the efforts of Greenpeace commandos and the International Whaling Commission notwithstanding.

Remarkable though it may seem, one possible solution to whale exploitation is private ownership. This suggestion has been made by a group of scientists who argue that the world's whales should be turned over to the (presently ineffectual) International Whaling Commission, which could then sell off the whales as private property to individuals, companies, or conservation groups, thereby raising money to finance its enforcement operations [2]. Property rights in whales would give owners a strong incentive to protect the creatures and to increase their numbers through breeding. The IWC would be charged with the duty of protecting the privately owned whales from the poachers.

John Majewski has made a similar proposal [3]. Although he does not indicate who would enforce the property rights in whales, he makes an interesting suggestion concerning the technical aspects of enforcement. Maintaining property rights in whales on the open sea may seem like a hopeless task. But as Majewski suggests, radio tracking technology could provide a partial solution. Whales generally travel in groups called 'pods' and follow regular migration paths. Whales in these pods could be tagged with transmitters broadcasting on unique frequencies. The pods could then be auctioned to individuals, companies, or groups, while the varying transmission frequencies would allow owners to distinguish among the pods and to track and thereby protect their own.

Private ownership of whales may seem like an odd concept at first, but it may well be the best solution to the problem of over exploitation. The difficulties of enforcement, both political and technical, are not insurmountable, and the two proposals discussed above offer innovative ways out of some of these difficulties. Moreover, enforcing private property rights in whales should be no more difficult than trying to enforce international prohibitions on whaling. The only real obstacle to the creation of property rights in wild animals like whales is simply the 'commons mentality' that has been ingrained in most of us. But an inability to accept the necessity of property arrangements for whales and other endangered wild animals may very well lead to their extinction.

Of course, some species groups (and whales may be an example) may be technically quite difficult to assign to the protection of private owners or voluntary groups, especially if their life habits make them difficult to track or to exclude poachers from them. But such technical problems can be quite practically overcome right now for many ground-based species, and to start by establishing a functioning legal framework for the ownership and protection of these species might provide a useful demonstration effect that can be transferred subsequently to the more difficult creatures. Interestingly, the first attempts at such husbandry are already stemming the population decline of a number of big game species, including the African elephant.

Saving the elephant

In the past ten years, the African elephant population has halved. Poachers kill African elephants to acquire their ivory tusks, which are highly prized

commodities. But again, this wanton destruction of a valuable natural resource, though truly a tragedy, is only to be expected, given the lack of property rights in elephants.

Commentary on the matter has usually failed to take the non-property status of elephants into account. A 1989 article by Elspeth Huxley, a distinguished writer on Africa, is a good case in point [4]. Huxley argues that 'the ruthless greed of man' is to blame for the senseless slaughter of the African elephant, and that the ivory poachers are part of 'a highly organized international racket, bringing fat profits to middlemen and sometimes to high-ups in the governments of the countries concerned'. The ivory trade is also cruel and wasteful: poachers 'mow down every mature and semi-mature animal in sight, leaving some to die in agony'.

However, these characteristics of the ivory trade are a result of the non-property status of elephants. The profits of ivory poachers are high for the same reason that the profits of drug smugglers are high. When the supply of a product is artificially restricted through government regulations or bans, distributors of the product are in a position to reap considerable financial gains. Ivory is extracted in a cruel and wasteful manner precisely because ivory poachers must quickly kill off any elephant they come across, extract its ivory, and make a fast getaway before the park rangers arrive. Such wasteful and needlessly cruel methods would not be used if the elephants were privately owned and husbanded, as cattle are owned and husbanded by ranchers for legal exploitation at maturity. (It is interesting that the 'ruthless greed of man' has not driven the cattle population to the verge of extinction.)

Elspeth Huxley's very orthodox solution to the poaching problem is to commit more international money for anti-poaching efforts and demand the comprehensive banning of the ivory trade. But while these measures may have some emotional appeal, they will only make the problem worse. The profits to the ivory poachers will increase as the supply becomes more circumscribed, and the temptation to poach will therefore be augmented [5]. Cruelty and wastefulness in the extraction process will rise as well, as poachers are pressed even more for time by better policing in the parks.

A solution not considered by Huxley is the possibility of selling off some of the wild elephants to private owners. These elephants could then be legally raised, bred, and killed at maturity for their ivory tusks (and other products that can be obtained from elephants) or even left to wander about unmolested for the benefit of wealthy tourists on 'photo safari' holidays. Indeed, this source of income is already helping to conserve big game in the (private) reserves of Southern Africa, to the considerable delight of the tourists, profit of the operators, and benefit of the game species. Such commercial husbandry of African elephants has produced an *increase* in their numbers in some countries [6]. Instead of being regarded as a worthless nuisance which destroys trees and crops (and sometimes houses), the elephants on such reserves have a real value to people and so are protected as a result.

By creating a legal market in ivory and other elephant products (and tourist services) through the privatization of some wild elephants, the population of the species would increase dramatically, causing the price of ivory to plummet from its present artificially high black-market level. These low ivory prices would eliminate any possible windfall profits to be gained from poaching on government lands. The wild elephants remaining in the national parks of Kenya and other countries would be that much safer from the predation of 'greedy' poachers.

PREVENTING POLLUTION

Pollution of the commons presents serious environmental policy problems. As noted, several market-oriented solutions have already been applied successfully ranging from effluent charges to privatization. Numerous other proposals for market reform have been made, however, and they offer the potential for efficient reductions in air and water pollution.

Air pollution effluent charges

Jo Ann Kwong has examined in depth the environmental problems of Hong Kong, particularly air pollution [7]. Presently, Hong Kong uses a licensing approach, a system that 'lies somewhere between emission fees and direct standards' [8]. This method has definite limitations, however, because it seeks to control directly the types and quantities of pollutants discharged as well as to specify the locations for discharge. The information required to run such a system efficiently is immense; and as a result it suffers from many of the weaknesses of a command-based system.

As an alternative, Kwong suggests that people be billed for their pollution, based on metered readings of different types of emissions. This rules-based method of pollution control could be used on both stationary and automotive sources.

The concept of an effluent charge on automobile emissions is quite innovative. As Kwong notes, some states in the US have mandatory automobile emissions tests that are run by private garages and paid for by the driver; and now the UK has instituted similar measures as part of the MOT inspection. These programmes, however, require drivers to meet specific emission levels, not to reduce them below that arbitrary ceiling. Kwong argues that if cars were taxed based on the *amount* of emissions released, there would be additional incentives to reduce emissions. The determination of effluent output could be made by measuring the level of emissions released by the automobile over a test run of one mile and multiplying that number by the number of miles elapsed on the kilometer since the last inspection.

Using per-unit fees rather than specific emission-level requirements will lead to greater efficiency. Drivers will have an incentive to adjust their pollution output to optimal levels. Furthermore, by accurately reflecting the social costs of

pollution, effluent charges provide better incentives to develop innovative antipollution techniques [9].

Tradeable permits

One of the first major policy decisions of President Bush's administration was for sweeping revisions of the Clean Air Act, dealing with acid rain, urban air pollution, and toxic air emissions. The 1990 amendments contained several market-oriented provisions [10].

The most notable of these was the enactment of marketable pollution permits to control acid rain problems. This emissions-trading is designed to make protection from acid rain achievable in a less costly fashion than many of the more traditional 'command and control' proposals that have been advanced. In addition to being easy and inexpensive to administer, such a system provides incentives for utilities to sponsor research into antipollution technologies [11].

Emissions trading can also alleviate the problem of poor urban air quality. The use of emissions trading in the control of both urban air quality and SO₂ discharges is another encouraging sign that market-oriented solutions are gaining ground.

In the United Kingdom, the Department of the Environment is financing independent economic research into the possible use of tradeable permits, alongside other instruments, as a mechanism to control longer-term acid deposition.

However, emissions-trading mechanisms inevitably face some daunting political obstacles, both from those who do not understand it and those who manage or benefit from the present structures. As a 1988 congressional report put it:

One potential difficulty with the approach is that it will require regulators to change the way they think about their jobs. No longer will regulators be in the business of evaluating different pollution control technologies and strategies. Firms will do that for themselves, driven by the price of continued pollution . . . Regulators may at first feel that they have less control over the system, because actual pollution control decisions will be made by polluters, not by the government. This, of course, is the whole point of the marketable permit system. The system will be effective only if this decentralization of decision making is allowed to work [12].

The main advantage of rules-based systems such as the marketable permit system is precisely this ability to harness decentralized knowledge and improve efficiency. Already, brokerage firms such as AER*X have set up, helping permit owners and buyers to trade permits in response to their constantly changing needs.

The same Congressional report suggests the use of economic incentives in several other areas as well. It recommends that the government should remove barriers to voluntary water marketing and create a system of tradeable permits for point-source water pollution [13]. For timber and wetland management, the report urges the elimination of federal subsidies and tax credits that encourage uneconomical tree-felling and wetland drainage and conversion [14].

CONSERVING NATURAL RESOURCES

Managing the use of natural resources is an important issue in environmental policy. Yet again, this task is, for many reasons, far better carried out by private individuals than by the state. Private owners, unlike public managers, have to consider the opportunity costs of their actions; responsibility is tied to authority. And in fact, private-property schemes can be used to improve the quality of natural resource management in some surprising areas -- such as water resources, the seabed, and the tropical rainforests.

Underground water resources

Water shortages have become a serious problem both in the United Kingdom and even more so in the United States -- where they have become a cause of great public concern [15]. The problem, however, may be more apparent than real. Many shortages are due, not to any long-term shortage of water, but to a faulty system of property rights in underground water resources [16].

In reviewing this problem, David Fractor notes that groundwater is both a stock and a flow resource. The **stock** is the amount of water in the reservoir. The **flow** is the amount of water that 'recharges', or replenishes, the stock. Poorly defined property rights have led to the 'overdraft' of reservoirs -- ie, the use of water at a rate higher than the flow. This overdraft, which depletes the available stock, leads to problems such as saltwater intrusion. Currently, 26 percent of the 82 billion gallons of water used daily in the United States is overdraft [17].

Fractor concurs that the cause of this overdraft is poorly defined property rights in underground water resources. He examines current US water law using three economic criteria: the certainty of water rights, the exclusiveness of water rights, and the transferability of water rights. If these criteria are not adequately met, inefficiency will result.

On the first criterion, Fractor argues that the present system of ownership is fraught with uncertainty. Some of the legal rules used to determine groundwater rights do not specify the quantities of water that rights holders are entitled to use; some also put so-called junior rights holders in a precarious position [18]. The foremost cause of uncertainty, however, is that the laws of

most states declare that water must be put to 'beneficial' use. This term is not only vague, but its meaning is subject to judicial revision.

Exclusivity, or the prevention of third-party effects, is also weak under present groundwater law. Many states have discovered that the total of all allocated groundwater rights exceeds the flow, or recharge level. This situation produces a tragedy of the commons, as each rights-holder rushes to get his share of water before the total stock is used up. To prevent this, some areas have imposed limits on pumping, a drastic and inefficient solution to the problem [19].

Finally, the transferability of rights, an essential feature of an efficient system of water allocation, has been strictly curtailed. Most states do not allow water to be sold outside their boundaries unless reciprocal agreements exist; many prohibit the sale of water from government-defined 'groundwater zones'. In some states the mere transfer of rights puts the rights themselves in jeopardy. Under the 'beneficial use' doctrine, the desire of a water rights-holder to transfer his rights can be legally construed as an admission that he was not using the rights 'beneficially' in the first place; and the courts can nullify the rights on these grounds [20].

Fractor argues that these problems with current doctrine can be solved by a stricter definition of groundwater rights. Under Fractor's scheme, groundwater rights would be two-part rights. A **perpetual right** would be granted for groundwater's flow component, and each user would receive a **fixed percentage** of the long-run average annual recharge. The stock component would be allocated as a once-and-for-all property right that could be exercised at any time. The entire groundwater stock, however, might not be allocated: to avoid the many environmental problems that may arise from excessive overdraft, a hydrologic study of the reservoir would be performed to determine how much water could be safely removed, and it is this 'safe' amount of 'surplus' stock that would be allocated [21].

Groundwater property rights under this scheme would be certain, exclusive, and easily transferable. Owners would know with certainty the exact amount of water they are entitled to. No 'beneficial use' doctrine would exist; market forces would shift water rights to the most highly valued uses. Finally, in areas where demand is high, water prices would rise accordingly, causing users to be less profligate in their use. Complete privatization of groundwater resources would both improve the efficiency of allocation and provide incentives for conservation -- a clear improvement over the present system.

Water metering in the UK

The National Rivers Authority has proposed metering as a solution to overdraft problems in the UK, where most households are charged for water and sewerage services according to the value of the house rather than any measure of use. Not

surprisingly, since water use is regarded as 'free' by households, it is often squandered unnecessarily.

The total demand for water has increased by about 70% in the last thirty years, and overabstraction is lowering the natural underground water levels, causing rivers to dry up and disappear. Some forty rivers are overabstracted, according to the NRA, and two years of dry weather has made the problem worse.

National metering trials began in 1988 when the water supply industry was being privatized. In the Isle of Wight, 53,500 properties were covered by the trial, and a further 8,570 were included in eleven other small-scale trial sites. These trials demonstrated that metering is certainly feasible for around 95% of households, and that it does indeed promote private conservation of this precious resource [22]. Consumers cut their consumption by about 10% on average when meters are installed.

Typically, the installation cost of meters is about £165-£200, but self-installation is feasible. Severn Trent Water supplies a free meter and customers then face DIY costs of about £30-£70. East Worcester Waterworks Company supplies DIY kits for £76 [23]. About half of the water companies reject metering because they consider that the enormous capital expenditure entailed in metering each home could not be covered by future savings.

The other half support metering, however: not just because it makes customers more careful with their use of water, but because it helps them measure total flows and -- by comparing what has gone into the distribution system and what has come out through everyone's meters -- to locate and quantify leakages. An estimated 25% of water entering the distribution system never reaches the consumer but is lost from leaks in the pipework. That means that purification and distribution costs are unnecessarily high by a very large amount.

It also means that we have more reservoirs than we need. These are expensive, of course -- the Kielder Water in Northumbria, the largest in the UK, cost £174 million to construct in 1983 (almost £300 million in today's equivalent). And reservoirs inevitably conflict with other countryside interests and commercial uses of the land area.

Once again, differential pricing can solve many of the 'public goods' problems of water supply. Most developed countries in the world meter water routinely, and over 25 million new ones are installed each year. A two-part tariff is the most common payment method, where customers pay a standing charge towards the general service costs, plus a charge per unit of water used. Economy during periods of drought can be encouraged by raising the charges for the amount used. Standing charges can be waived for people on low incomes, so that their bills are lower but they still pay according to usage. And lower use charges on the initial amount of water considered essential for health and hygiene are applied in Italy, Belgium, Greece, and Portugal.

The seabed

The natural resources offered by the world's oceans are tremendous. These resources include petroleum, manganese and phosphorite nodules, seaweed, shellfish, and other oceanic life forms. The eventual exploitation of these resources will have widespread economic ramifications.

In *Markets under the Sea?* [24], Donald Denman examines the present system of seabed holdings by national governments and the UN's proposed system of international ownership of deep ocean resources, which failed when the United Kingdom, United States, and other countries refused to ratify the draft treaties. He then suggests improving ocean management through privatization.

As Denman notes, the Territorial Sea Convention of 1958 confirmed the 'sovereign rights' of nations over their continental shelves [25]. National governments may also grant leases and licences to private individuals and companies for the use of this seabed. For instance, national governments commonly offer ocean-drilling leases to petroleum companies.

But the oceanic regions beyond the continental shelves were declared 'the common heritage of mankind' by the United Nations [26]. This vague declaration was fleshed out by the Law of the Sea Convention, which proposed the creation of the International Seabed Authority (ISA). The ISA was to have supreme authority over the deep-ocean bed, with complete power over all resources in an underwater area covering approximately 60 percent of the globe. In short, the Convention, if ratified, would have created the largest monopoly in the world [27].

Denman argued that continued governmental control of the continental shelf and the proposed creation of an international seabed monopoly were both steps in the wrong direction. Governmental management of oceanic resources has many drawbacks. Leases on continental-shelf areas offered by national governments, for instance, are often distributed arbitrarily (especially in the North Sea), and the leases themselves are often granted for uneconomically short periods. Most important, however, the government is in the position of a monopolist; the prices of leases may be much higher under the present system than they would be in a competitive environment [28].

Denman sees the pathway to reform as a difficult one to travel. The present system has tremendous inertia, and present beneficiaries (such as oil companies) often prefer the certainty of government management, however wasteful, to the uncertainty of a scheme of competitive bidding for underwater property [29]. Nevertheless, Denman argues that a system of absolute private ownership of the seabed would unleash the dynamic and creative powers of the free market.

Alternatively, barring absolute ownership, which Denman admits may be politically infeasible, long-term leases and the auctioning off of derivative rights (eg, the right to dredge areas of the seabed) can be used to bring market forces

into play [30]. Due to the poor information and incentives that the political authorities would face, one would expect private ownership of the seabed to be far superior to the current system in terms of both efficiency and conservation.

Tropical rain forests

The deforestation of tropical regions has become a matter of growing concern among scientists, economists, and environmentalists. Tropical forests, which once covered ten percent of the earth's land surface, have been reduced by a third. Moreover, biologists estimate that over 10,000 species are being lost each year because of reckless deforestation. Why is this deforestation taking place?

Brazil is home to nearly a third of the world's remaining rain forests [31]. Jane Shaw, writing on the crisis of deforestation [32] notes that Brazilian government policies are actually encouraging deforestation of the rain-forest through subsidies and tax credits [33]. There have been explicit and disguised subsidies for cattle ranching and settlements by small farmers -- both of which are major causes of deforestation [34]. The International Monetary Fund helped pay for the Polonoroesta Plan, which aimed to develop 100,000 square miles of forest for use by small farmers. Meanwhile, agriculture has been taxed more leniently than other businesses, with land tax charged on unimproved land but reduced by 90% on agricultural land [35]. The forest-products industry similarly has been similarly endowed with state subsidies.

The power of these subsidies is large, though only recently have bodies such as the World Bank admitted that their aid, lending, and subsidy policies have contributed to deforestation [36]. By way of illustration, Brazil's subsidies on deforestation for ranching were abolished in 1988 by Jose Sarney's government, and such deforestation fell by thirty per cent.

Some of the subsidies were revived by the 1991 Finance Bill; but now Fernando Collor, the President of Brazil, has made the total elimination of all such subsidies a major part of his environmental policy. However, other government programmes beyond explicit subsidies continue to contribute to the problem. Brazil's intensive roadbuilding project, for example, has opened up new domestic markets for beef by making cattle more easily transportable. That in turn makes ranching more attractive, putting further pressure on the forest [37].

Of course, if Brazilian ranchers and farmers had to bear the full costs of their actions, they would not find present rates of deforestation economical. Under a strict system of private property, one undistorted by extensive subsidies and tax credits, many owners would prefer to hold the rain forests speculatively or to sell the land to foreign environmentalist organizations, such as the Worldwide Fund for Nature and the Nature Conservancy (which already protects over four million acres of it). A fully functioning price system would force the owners of this property to take into account the opportunity costs of their actions. And without the present tax incentives, the owners of tropical rain forests would recognize the

numerous pecuniary advantages of preserving rare ecosystems. This is true not only in Brazil, but in other countries where government policies are working to induce deforestation [38], such as the United States, where subsidies meet 98% of the cost of tree-felling in Alaska's Tongass National Forest, one of the last large temperate forests in the world.

Clearly, the fundamental factor in deforestation is not just subsidies which promote it, but the lack of any ownership of the forest wilderness itself, which produces another 'tragedy of the commons'. Introducing private ownership rights into something that is regarded locally as unowned and of little permanent value, however, could be difficult.

The Asian Development Bank has put forward a scheme which would take the first step towards creating property rights in the tropical forests, and may be worth further thought [39]. Basically, the plan is to give tree-felling rights to whoever offers to post the highest guarantee bond. This bond would be invested for the lifetime of the agreement, but could be forfeited if the forestry company failed to protect the forest (by replanting, say, or by avoiding particularly sensitive areas and species). Such a system would encourage sustainable forestry and the elimination of waste -- it is an instructive fact that while Sweden's forest products industry uses 98% of each tree it fells, Malaysia uses only about 40% [40].

Another idea is to award perpetual leases to forestry companies, charging an annual rent that is reviewed periodically. Making the leases tradeable would help provide an incentive to maintain the value of the concession, and so again encourage replanting, good husbandry, and efficiency in resource use.

Countryside areas

Closer to home, much can be done to improve the incentive structure that has devastated so much of the UK's countryside. The perverse effects of the Common Agriculture Policy in promoting large-scale farming, grubbing up hedgerows, and using fertilizers which then leach into waterways, has already been noted as a problem. There is, however, a growing feeling in Europe that the CAP's subsidy network needs reform and reduction, and deadlock over the Uruguay round of GATT brought this to something of a head.

Meanwhile the UK government, unable on its own to change the environmentally perverse structure of the CAP, has set up counterweight schemes. In 1986, for example, a number of Environmentally Sensitive Areas were designated, and farmers who agreed to eschew intense farming techniques and conserve the landscape would qualify for grants of up to £80 per acre [41]. The Broadleaved Woodlands Grant Scheme is a counterweight to subsidies favouring the (less environmentally sensitive and attractive) planting of pine forests.

As a further measure, Dr Barry Bracewell-Milnes recommends the abolition of inheritance tax as a way to keep farms and heritage assets in the hands of owners with a long-term interest in their conservation. Since conservation tends to reduce current earnings but increase the longer-term capital value of assets, there would seem to be a similar case to be made for the elimination of capital gains tax on farmlands, woodlands and heritage property.

PROSPECTS FOR REFORM

Clearly, market environmentalism is applicable to the real world of environmental problems. Not only have market principles been successfully (though usually unconsciously) applied to environmental problems ranging from pollution and wildlife conservation to the provision of park services, but they have also provided a foundation for future reforms and research.

One of the greatest barriers to the successful use of market environmentalism is the sheer inertia of our present way of thinking about the environment. Most of us think of environmental amenities -- from clean air and water to tropical forests -- as free goods. This attitude may have made some sense before industrialization and the extensive use of commons areas. Now, environmental amenities can no longer be considered free goods. Policies that treat them as such will lead to the continued abuse of natural resources.

Like all other goods, the environmental goods that we all enjoy come at a price. Making this price explicit through privatization, effluent charges, and other means would improve the efficiency and effectiveness of environmental policies. Or we can continue to keep this price hidden, as we are doing with present 'command and control' policies. This second approach will not solve pressing environmental problems at all, but will lead to continued and increasing environmental degradation around the globe.

A transitional policy that moves us toward a rules-based regime could tempt those vested interests in several ways, however. For instance, discount rates for marketable pollution permits could be offered to established industries. Such new-time inducements could be an effective method of undermining political support for the current regime of environmental legislation [1].

The second barrier to enacting rules-based reforms in environmental policy is perhaps more difficult to overcome. It is the attitude which many people have towards environmental control: the belief that environmental quality can be maintained only through government management. Even some defenders of the market economy seriously doubt the potential efficacy of market solutions to environmental problems [2].

6. CONCLUSION: A MARKET ENVIRONMENTAL POLICY?

“Look abroad through Nature’s range
Nature’s mighty law is change.”

Robert Burns

As the costs of our command-based environmental policies continue to grow, more efficient approaches will have to be considered. Streamlining the present system and attempting to adopt businesslike management are both dead-end approaches: these superficial reforms would not fundamentally change the nature of either the information or the incentives with which political and economic agents deal. Only by moving toward a rules-based environmental policy that relies on private-property rights, liability laws, and other market mechanisms will real progress be made in the promotion of environmental quality.

Barriers to reform

As noted, two major barriers are obstructing the path to sound environmental control. One barrier is the vested interest that present polluters have in our current command-based regulatory system, which acts to cripple small and newly established businesses. The current system, costly though it is, provides some industrial stability and secure profits to established firms.

A transitional policy that moves us toward a rules-based regime could ‘co-opt’ these vested interests in several ways, however. For instance, discount rates for marketable pollution permits could be offered to established industries. Such one-time inducements could be an effective method of undermining political support for the current regime of environmental regulation [1].

The second barrier to enacting rules-based reforms in environmental policy is perhaps more difficult to overcome. It is the attitude which many people have towards environmental control: the belief that environmental quality can be maintained only through government management. Even some defenders of the market economy seriously doubt the potential efficacy of market solutions to environmental problems [2].

Breaking down this second barrier may be much more difficult than breaking down the first one. The idea that greater complexity requires greater control is entirely fallacious, as we have seen, but many people continue to believe it nonetheless. Real progress in environmental policy may never be made until the public is convinced that self-ordering markets offer a superior alternative to direct government action.

An emerging consensus?

This reluctance to adopt rules-based policies for the environment is a symptom of an underlying malady. In the modern era, faith in the market has diminished as faith in the state has risen. One result has been a substantial increase in the discretionary power of centralized governments, of which discretionary environmental policy is only one facet.

Around the globe, however, auspicious signs have recently emerged to indicate a growing dissatisfaction with government management of economic affairs. From the Americas to Eastern Europe and China, market reforms have been introduced and relied on more and more. There are indications that this new reliance on market principles is being applied, hesitantly, into environmental policy. Perhaps with a little more experience of market environmental mechanisms, and with a good deal more understanding, this new strategy will become the norm rather than the exception.

NOTES TO CHAPTER 1

1. Green product lines have become quite popular elsewhere as well. See Susan Dillingham, 'Hawking Consumer Goods with the Environmental Pitch', *Insight*, 26 March 1990, pp 40-2.
2. 'Global Warming -- or Perhaps Not', *The Economist*, 2 December 1989, p 99. Also see Deepak Lal, *The Limits of International Co-operation: Occasional Paper 83* (London: Institute of Economic Affairs, 1990) pp 25-34; Carolyn Lochhead, 'Global Warming Forecast May be Built on Hot Air', *Insight*, 16 April 1990, pp 14-8; and David Warsh, 'Game Theory Suggests Quick Action on Greenhouse Effect is Remote', *Washington Post*, 13 June 1990, p B3. 'US to Siphon Billions for Acid Rain Hoax', *Citizen Outlook* (Newsletter for the Committee for a Constructive Tomorrow), Winter 1990, pp 1,4. Kent Jeffreys, *Why Worry About Global Warming?* (Dallas: National Center for Policy Analysis, 1991), Hilary Lawson, *The Greenhouse Conspiracy* (London: Television and Film Productions, 1990), James E Lovelock, 'The Earth is not Fragile' (Lecture at Linacre College, Oxford, 24 January 1991).
3. David Pearce, Nail Markandya, and Edward B Barbier, *Blueprint for a Green Economy* (London: Earthscan Publications, 1989), p 161.
4. See for example Tom Tietenberg, *Environmental and Natural Resource Economics* (Glenview, IL: Scott, Foresman and Company, 1988), p 40; Marshall Goldman, 'The Convergence of Environmental Disruption', in Morris Bornstein, ed, *Comparative Economic Systems: Models and Cases* (Homewood, IL: Richard D Irwin, 1974), pp 467-79; 'The Poisoned Giant Wakes Up', *The Economist*, 4 November 1989, pp 23-6; and Judith Perera, 'A sea left high and dry', *The Daily Telegraph*, 21 July 1990, p 2 (weekend section).
5. See Joseph S Berliner, 'Managerial Incentives and Decision Making: A Comparison of the United States and the Soviet Union', in Bornstein, *op cit*, pp 396-427.

NOTES TO CHAPTER 2

1. Garrett Hardin, 'The Tragedy of the Commons', *Science*, December 1968, pp 1243-8.
2. David Hume, *A Treatise of Human Nature* (Oxford: Oxford University Press, 1888), p 538.
3. Scott Gordon, 'The Economic Theory of a Common Property Resource: The Fishery', *The Journal of Political Economy*, April 1954, pp 124-42.
4. Arthur Pigou, *The Economics of Welfare* (London: Macmillan, 1920).
5. Adam Smith, *The Wealth of Nations* (Indianapolis: Liberty Classics, 1976), vol. 2, p 723.
6. Paul Samuelson, 'The Pure Theory of Public Expenditure', in Tyler Cowen, ed., *The Theory of Market Failure* (Fairfax: George Mason University Press, 1988), p 29.
7. Also see Francis Bator, 'The Anatomy of Market Failure', in Tyler Cowen, ed, *The Theory of Market Failure*, pp 35-66. For a classic defence of marginal-cost pricing (which would mean free provision for public goods) see Harold Hotelling, 'The General Welfare in Relation to Problems of Taxation and of Railway and Utility Rates', *Econometrica*, July 1938, pp 242-69.
8. Frank Knight 'Some Fallacies in the Interpretation of Social Cost', *Quarterly Journal of Economics*, August 1924, pp 582-606.
9. John Baden and Richard Stroup, *Natural Resources: Bureaucratic Myths and Environmental Management* (Cambridge: Ballinger, 1983), and 'Property Rights and Natural Resource Management', *Literature of Liberty*, October/December 1979, pp. 5-44.
10. Earl Brubaker, 'Free Ride, Free Revelation, or Golden Rule?' in Cowen, ed, *The Theory of Market Failure*, pp 93-109.
11. Another excellent article dealing with the use of pre- contract exclusion to effect the private production of collective goods is David Schmitz, 'Contracts and Public goods', *Harvard Journal of Law and Public Policy*, Spring 1987, pp 475-503.
12. Harold Demsetz, 'The Private Production of Public Goods', in Cowen, ed, *The Theory of Market Failure*, pp 111-26.
13. Roughly, at least. As a practical matter, companies that provide public goods charge consumers according to broad classifications that are easy to work with. For instance, theatres charge different prices for adults, students, and senior citizens. Airlines discriminate between business travellers and leisure customers who are able to accept different restrictions on flight times and availability. The process of differentiating the market into classes of consumers with different product valuations is often quite difficult, and may be simply impossible in many cases.

NOTES TO CHAPTER 3

1. Such as A C Pigou, already mentioned, who implicitly treats government as an almost superhuman agency which costlessly pursues the common good. As Pigou states in *The Economics of Welfare*: 'It is, however, possible for the State, if it so chooses, to remove the divergence (between private and social costs) in any field by extraordinary encouragements or extraordinary restraints upon investments in that field' (emphasis added; *The Economics of Welfare*, 4th ed., p 192). As has been noted, this ideal conception of the state bears little resemblance to reality.
2. See Harold Demsetz, 'Information and Efficiency: Another viewpoint', *Journal of Law and Economics*, April 1969, pp 1-22.
3. David Pearce, Anil Markandya, and Edward Barbier, *Blueprint for a Green Economy* (London: Earthscan Publications, 1989), p 24.
4. Carolyn Lochhead, 'The Alarming Price Tag on Greenhouse Legislation', *Insight*, 16 April 1990, pp 10,12.
5. Barry Bracewell-Milnes, *Caring for the Countryside: Public Dependence on Private Interest* (London: Social Affairs Unit, 1987)
6. *Ibid*, p 6
7. *Ibid*, p 10
8. Doug Bandow, 'A New Approach for Protecting the Environment', in Doug Bandow, ed, *Protecting the Environment: A Free Market Strategy* (Washington, DC: The Heritage Foundation, 1986), p 11. As Bandow notes, US government ownership ranges from 0.3% of Connecticut to a staggering 86.5% of Nevada. (*Ibid*, p 11).
9. *Ibid*, pp 12-3.
10. Yellowstone was designated as the first national park in 1871, and the Reclamation Acts were passed in 1902. (*Ibid*, p 3).
11. John Baden and Richard Stroup, *Natural Resources: Bureaucratic Myths and Environmental Management* (Cambridge: Ballinger Publishing Co, 1983), pp 111-2. Also see Randal O'Toole, *Reforming the Forest Service* (Washington, DC: Island Press, 1988).
12. Bandow, *op cit*, p 12. Bandow also notes that 'In 1983, the taxpayers got back a mere two cents for every dollar they invested in lumber leasing in Alaska!' (*Ibid*, p 12).
13. Four sources offer particularly good analyses of current US public forestry management. See Barney Dowdle, 'An Institutional Dinosaur with an Axe: Or, How to Piddle Away Public Timber Wealth and Foul the Environment in the Process', in John Baden and Richard Stroup, eds, *Bureaucracy vs Environment: The Environmental Costs of Bureaucratic Governance* (Ann Arbor: The University of Michigan Press, 1981), pp 170-85, and also Robert Deacon and M Bruce Johnson, eds, *Forestlands: Public and Private* (Cambridge: Ballinger Publishing Company,

- 1985). Alston Chase, and environmental activist, has also written a superb book detailing the disastrous consequences of the National Park Service's management of Yellowstone. See Alston Chase, *Playing God in Yellowstone: The Destruction of America's First National Park* (Boston: The Atlantic Monthly Press, 1986). Finally, for a look at public forestry management in Britain, see Robert Miller, *State Forestry for the Axe* (London: Institute of Economic Affairs, 1981).
14. Sabine Kremp, 'A Perspective on BLM Grazing Policy', in Baden and Stroup, eds, *Bureaucracy vs Environment*, p 124.
 15. Bandow, *op cit*, p 13.
 16. Baden and Stroup, *Natural Resources*, pp 47-8.
 17. *Ibid*, p 46.
 18. Lloyd Orr, 'Social Costs, Incentive Structures, and Environmental Policies', in Baden and Stroup eds, *Bureaucracy vs Environment*, pp 51-2, and Baden and Stroup, *Natural Resources*, pp 90-2.
 19. Statistic from White House Fact Sheet on President Bush's Clean Air Proposal, 12 June 1988, p 3.
 20. Paul Portney, *Public Policies for Environmental Protection* (Washington, DC: Resources for the Future, 1990), p 71. This conclusion was reached from data provided in Tom Tietenberg, *Emissions Trading: An Exercise in Reforming Pollution Policy* (Washington, DC: Resources for the Future, 1985).
 21. Orr, *op cit*, p 55.
 22. *Ibid*, p 55.
 23. 'Best practicable technology', determined by the industry average, was required of dischargers by July 1, 1977. 'Best available technology', determined by the best performance in an industry, was required by July 1, 1983. (*Ibid*, p 52).
 24. As Bandow notes: 'The EPA attempts to prescribe specific abatement technologies for some 200,000 polluting facilities . . .' -- a formidable task, no doubt (Bandow, *op cit*, p 7). For a superb study detailing how the Clean Air Act became a political football among eastern congressmen, western congressmen, and coal producers of the respective regions, see Bruce A Ackerman and William T Hassler, *Clean Coal/Dirty Air* (New Haven: Yale University Press, 1981).
 25. Orr, *op cit*, p 55.
 26. Bandow, *op cit*, p 15.
 27. See James Bovard, 'Bankrupt Environmentalism', *New York Times* 9 July 1985.
 28. Maurice R Greenberg, 'Avoiding the Liability Trap', *World Link* August 1991, pp 22-24.
 29. Bandow, *op cit*, p 15.

30. Maurice R Greenberg, *op cit.*
31. For one of the first articles written on the subject of market environmentalism see Terry L Anderson, 'New Resource Economics: Old Ideas and New Applications', *American Journal of Agricultural Economics*, December 1982, pp 928-34. Also, see Samuel Brittan, 'The green power of market forces', *Financial Times*, 4 May 1989, and Michael D Nahan, *Environment: Conservation and Economics* (Perth, Western Australia: Australian Institute for Public Policy, 1986).
32. Terry L Anderson and Donald R Leal, *Free Market Environmentalism* (San Francisco: Pacific Research Institute, 1991), chap 2.
33. *Ibid*, p 3
34. *Ibid*, p 4.
35. *Ibid*, p 5.
36. For proposals on a road pricing policy for the UK, see John Hibbs and Gabriel Roth, *The Management of Roads in a Free Society* (London: Adam Smith Institute, 1991).
37. See *Altered Estates* (London: Adam Smith Institute, 1988).
38. For views on this see *An Environment for Growth* (London: Adam Smith Institute, 1987).
39. See Terry L Anderson, *Water Crisis: Ending the Policy Drought* (Washington, DC: The Cato Institute, 1983).
40. See D R Denman, *Markets Under the Sea?* (London: Institute of Economic Affairs, 1984).
41. Barry Bracewell-Milnes, *Caring for the Countryside: Public Dependence on Private Interest* (London: Social Affairs Unit, 1987), p 1.
42. Jo Ann Kwong, *Market Environmentalism: Lessons for Hong Kong* (Shatin, Hong Kong: Chinese University Press, 1990), p 37.
43. For overviews of market-oriented regulations, see Dieter Helm and David Pearce, 'Assessment: Economic Policy Towards the Environment', *Oxford Review of Economic Policy*, v 6, no 1, pp 10-4, and Tom Tietenberg, 'Economic Instruments for Environmental Regulation', *Oxford Review of Economic Policy*, v 6, no 1, pp 17- 33.
44. In Pigouvian terms, the effluent charge would produce a convergence of marginal private costs and marginal social costs.
45. For a good analysis of effluent charges, see Wilfred Beckerman, *Pricing for Pollution*, 2nd edition (London: Institute of Economic Affairs, 1990).
46. 'Where There's Muck There's Brass', *The Economist*, March 17 1990, p 66.
47. A short discussion of marketable pollution permits is contained in William J Baumol and Wallace E Oates, *Economics, Environmental Policy, and the Quality of Life*

- (Englewood Cliffs, NJ: Prentice-Hall, Inc, 1979), pp 250-253. One interesting feature of this system is that, after its adoption, public demands for better air and water quality could be met by simply setting aside government funds to buy back and 'liquidate' pollution permits. In this way, the costs of environmental quality would be made explicit.
48. See Mark Cohen, 'Optimal Enforcement Strategy To Prevent Oil Spills: An Application Of A Principal-Agent Model With Moral Hazard', *Journal of Law and Economics*, April 1987, pp 23-51.
 49. Milton R Copulos, 'Disposing of Hazardous Wastes: How to Deal with the "Toxic Terror"' in Bandow, ed, *Protecting the Environment*, p 79.
 50. Also, insurance companies would probably demand that clients take proper precautions to minimize the risk of such a disaster. Insurance companies will want to avoid environmental disaster (and the subsequent payment of damages) just as much as the firms they insure.
 51. This fundamental distinction has been made by many writers, including Michael Oakeshott, *On History and Other Essays* (Totowa, NJ: Barnes and Noble Books, 1983), pp 119-64, and Friedrich A Hayek, *Law, Legislation, and Liberty, Volume 1: Rules and Order* (Chicago: University of Chicago Press, 1973).
 52. T Alexander Smith, *Time and Public Policy* (Knoxville, TN: University of Tennessee Press, 1988), pp 199-205.
 53. This conclusion is totally at odds with conventional wisdom. Often we hear people say that 'because our world is so complex, we must have governmental direction and intervention.' This attitude, though quite understandable, reflects a fundamental misapprehension of the facts of social and economic life. Planning may have been conceivable at some time in the past, when activities were much simpler and human groups were smaller. Given the immensely complex world in which we live, however, central direction would require a huge quantity of knowledge, knowledge that is presently possessed (often in a form that cannot even be communicated) by the many members of society. Complexity and the diffuse nature of knowledge mean that general, abstract rules, not commands, must be used to bring a modicum of order and coordination to social and economic life. For a fascinating discussion of this topic in relation to economic science, see F A Hayek, 'The Use of Knowledge in Society,' in *Individualism and Economic Order* (Chicago: Henry Regnery Co, 1972). Also, for a good discussion of the nature of knowledge see Thomas Sowell, *Knowledge and Decisions* (New York: Basic Books, 1980), pp 3-20, and Michael Polanyi, *Personal Knowledge* (Chicago: University of Chicago Press, 1958).
 54. Israel Kirzner has argued that command-type regulations in market economies suffer from much the same weaknesses as central economic planning. See Israel M Kirzner, *Discovery and the Capitalist Process* (Chicago: The University of Chicago Press, 1985), pp 119-49.
 55. For a groundbreaking discussion of 'demonstrated preference' theory and its application to economic science, see Murray Rothbard, 'Toward a Reconstruction of Utility and Welfare Economics,' in Mary Sennholz, ed, *On Freedom and Free Enterprise* (Princeton: D Van Nostrand C, 1956) pp 224-62. Also see S C Littlechild,

- 'The Problem of Social Cost', in Louis Spadaro, ed, *New Directions in Austrian Economics* (Mission, Kansas: Sheed, Andrews, and McMeel, 1978), pp 77-93.
56. See, for instance, V K Lippit and K Hamada, 'Efficiency and Equity in Intergeneration Distribution', in *Sustainable Society* (Wisconsin: A R Pragare Co, 1977).
 57. Richard Stroup and John Baden, 'Property Rights and Natural Resource Management', *Literature of Liberty*, October/December, 1979, pp 19-24. Also see J W Milliman, 'Can People be Trusted with Natural Resources?' *Land Economics*, 38(1962), pp 199-218.
 58. Stroup and Baden, *op cit*, p 21.
 59. *Ibid*, p 22.
 60. James Buchanan and Gordon Tullock, 'Polluters' Profits and Political Response: Direct Controls Versus Taxes', *The American Economic Review*, March 1976, p 142.
 61. *Ibid*, p 141.
 62. B Peter Pashigian, 'The Effect of Environmental Regulation on Optimal Plant Size and Factor Shares', *Journal of Law and Economics*, April 1984, p 2.
 63. George Stigler, 'The Theory of Economic Regulation', in *The Citizen and the State* (Chicago: The University of Chicago Press, 1975), pp 114-41.
 64. Maloney and McCormick, *op cit*, p 123.
 65. For an excellent review of industry efforts to turn environmental regulations to private ends, see Bruce Yandle, *The Political Limits of Environmental Regulation* (New York: Quorum Books, 1989).
 66. See F A Hayek, *The Constitution of Liberty* (Chicago: The University of Chicago Press, 1960), pp 11-21.
 67. William Baumol and Wallace Oates, *Theory of Environmental Policy* (Cambridge: Cambridge University Press, 1988), pp 9-13.
 68. Though both types of regulations may face information constraints, rules-oriented regulations are clearly superior *once an optimal level of pollution is decided upon*. In other words, the efficiency of regulations for pollution abatement has two components: first, the efficiency of any given level of pollution output; second, the efficiency of mechanisms designed to achieve this level of output. The first component may be beyond the reach of any environmental protection system, but the second is much more easily achieved by rules-oriented regulations.
 69. For a good overview of environmental problems and economically sound solutions, see Frances Cairncross, 'The Politics of Prosperity', *The Economist*, 2 September 1989, pp 5-24.

NOTES TO CHAPTER 4

1. 'The Vanishing Jungle: Ecologists make friends with economists', *The Economist*, 15 October 1988, p 25.
2. Matt Ridley, 'Privatizing America's West: Profits from the Wild', *The Economist*, 22 October 1988, pp 21-2. Dealers in wild game are one of the many licensed professions catalogued in Douglas Mason, *Licensed to Live*, (London: Adam Smith Institute, 1988)
3. Some states, however, maintain strict control over the management of wild animals on private lands. For example, Montana and Wyoming do not allow owners to set up private hunting preserves where game is managed as the owner pleases (*Ibid*, p 24).
4. Terry Anderson and Donald Leal, 'Rekindling the Privatization Fires: Political Lands Revisited,' *Reason* Foundation Federal Privatization Project, Issue Paper 108. Also, see Jo Ann Kwong, 'Private Hunting Provides Public Benefits', *Wall Street Journal*, 19 June 1987; Jo Ann Kwong, 'Evolving Institutions in Wildlife Management: The Case for Free Hunting', *Western Wildlands*, Spring 1988, pp 26-31; and *Policy Review*, Summer 1990, pp 63-4.
5. Anderson and Leal, *op cit*, p 12.
6. *Ibid*, p 13.
7. *Ibid*.
8. Nature Conservancy Background Information sheet, 1989.
9. Although, in direct contradiction to some of its advertising, it does receive some government funds. In 1987 alone, the Conservancy received \$230,000 in government grants, and engaged in 59 cooperative projects with government agencies in 1988. Jo Kwong Echard, *Protecting the Environment: Old Rhetoric, New Imperatives* (Washington, DC: Capital Research Centre, 1990), p 81.
10. John Baden and Richard Stroup, 'Saving the Wilderness', *Reason*, July 1981, pp 28-36.
11. 'The RSPB: What We Are and What We Do' (Sandy, Bedfordshire: Royal Society for the Protection of Birds, 1991).
12. For further examples of private wildlife conservation efforts, see Robert J Smith, 'Special Report: The Public Benefits of Private Conservation', *The Fifteenth Annual Report of the Council on Environmental Quality*, pp 368-78, 387-98, 412-8.
13. Founded by Irvin Naylor and the late Sir Antony Fisher.
14. Not only did the Cayman Turtle Farm periodically release turtles into the wild, but is also made customers sign contracts promising not to use wild sea turtle products!

15. Robert J Smith, 'Private Solutions to Conservation Problems', in Tyler Cowen, ed *The Theory of Market Failure* (Fairfax: George Mason University Press, 1988), pp 350-4.
16. Jane S Shaw and Richard L Stroup, 'Gone Fishin' ', *Reason*, August/September 1988, pp 34-7.
17. *Ibid*, p 36.
18. For an good review of both US government policy on air pollution and proposed market reforms, see Carolyn Lochhead, 'Pollutants Reined by Market Rules', *Insight*, 3 July 1989, pp 8- 17.
19. Senators Timothy E Wirth and John Heinz, *Project '88: Harnessing Market Forces to Protect Our Environment: Initiatives For The New President* (Washington, DC: December, 1988) pp 24-6.
20. Tom Tietenberg, *Environmental and Natural Resource Economics* (Glenview, IL: Scott, Foresman and Co, 1988), pp 345-6.
21. *Ibid*, pp 346-7.
22. *Ibid*, pp 347-8.
23. *Ibid*, p 348.
24. Robert W Hahn and Gordon L Hester, 'The Market for Bads: EPA's Experience with Emissions Trading', *Regulation*, 1987 Nos 3/4, p 51.
25. For a discussion of the limitations of the EPA's emissions trading system, see Robert W Hahn and Gordon L Hester, 'Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Programme', *Yale Journal on Regulations*, v 6, 1989, pp 109-53.
26. William Baumol and Wallace oates, *Economics, Environmental Policy, and the Quality of Life* (Englewood Cliffs, NJ: Prentice-Hall, 1979) p 256.
27. *Ibid*, p 256-7.
28. J B Opschoor and Hans B Vos, *Economic Instruments for Environmental Protection* (Paris: Organization for Economic Cooperation and Development, 1989), p40.
29. *Ibid*, pp 37-8, 41-3, and Baumol and Oates, *op cit*, pp 257-8. For a good review of European water pollution problems and possible solutions, see Ralph W Johnson and Gardner M Brown, Jr, *Cleaning Up Europe's Waters: Economics, Management, and Policies* (New York: Praeger Publishers, 1976).
30. 'Pollution-Related Health Damage Compensation Law Amended', *Japan Environment Summary*, 10 October 1987, p 1.
31. *Ibid*, p 1.
32. *Ibid*.

33. Nicholas Ridley, *Policies against Pollution*: (London: Centre for Policy Studies, 1989). For a similar proposal, see Christine McGourty, 'Call for Taxes to penalize polluters', *The Daily Telegraph* 20 July 1990, p 7.
34. That is to say, polluters should be charged, if possible in proportion to the burdens which their overspills impose on others, so that the social costs are internalized.
35. *This Common Inheritance* (London: HMSO, 1990) paragraph A1.
36. One problem with the idea of a fossil-fuels tax is that it provides no incentive for producing innovative antipollution techniques. If one were to reduce the effluent output of one's car through antipollution techniques *without* improving fuel efficiency, no private gain would result; one would still have to pay the same amount of fossil-fuel taxes as before, even though the social costs of pollution had been reduced.
37. 'Where There's Muck There's Brass', *The Economist* 17 March 1990, p 66.
38. Though like some other 'recycling' measures, this might not in fact be environmentally sound. Collecting and transporting used bottles, for example, requires extra journeys by lorries; since reasonable containers tend to be heavier, more fuel is used in delivering them; and being bulkier, they tend to take up more landfill volume when they are disposed of. On most environmental measures, disposable cartons would be superior to reuseable glass bottles. See Lynn Scarlett: *A Consumer's Guide to Environmental Myths and Realities* (Dallas: National Center for Policy Analysis, 1991).
39. S Owens, V Anderson, and I Brunskill, 'Green Taxes: A Budget Memorandum (London: IPPR, 1990).
40. Barry Bracewell-Milnes, *Caring for the Countryside: Public Dependence on Private Interest* (London: Social Affairs Unit, 1987), p 11.
41. Nicholas Baring, '1990 Finances', *The National Trust Magazine*, No 63, Summer 1990, pp 31-3.
42. *Guide to Over 100 Properties* (Edinburgh: National Trust for Scotland, 1991)
43. Anderson and Leal, *op cit*, pp 12-3.
44. *Ibid*, pp 12-3.
45. For a more detailed study of North Maine Woods, see Smith, 'Special Report: The Public Benefits of Private Conservation', pp 381-7.
46. Anderson and Leal, *op cit*, p 11.
47. *Ibid*.

NOTES TO CHAPTER 5

1. The problems of whale conservation exhibits most of the characteristics of a 'Prisoners Dilemma'. Although in the optimal solution to the problem all countries would cooperate, the best solution for any given country is to cheat while others obey the treaties. In essence, the countries who abide by the international whaling treaties are being 'suckered' by countries which do not.
2. 'Trends', *Reason*, November 1986, p 21.
3. John Majewski, 'Own Your Own Whale', *Economic Affairs*, October/November 1987, pp 45-6.
4. Elspeth Huxley, 'Man's avarice threatens the noblest species of all', *The Daily Telegraph*, 22 May 1989, p 18.
5. See 'Saving the Elephant', *The Economist*, 1 July 1989, p 17, and Jeffrey Bartholet, 'A Tussle Over Tusks: African nations debate a ban on the ivory trade', *Newsweek*, 24 July 1989, p 25.
6. In Botswana, Zimbabwe, South Africa, and Namibia, elephant populations have been increasing at the rate of 5 percent per year. This increase has resulted from the management of elephants for commercial use on both private and public lands. Private owners, of course, have a strong incentive to preserve and protect their elephants for pecuniary reasons. On public lands, the managers use the proceeds from ivory sales to finance park budgets. See Randy Seimmons and Urs P Kreuter, 'Save an Elephant -- Buy Ivory', *Washington Post* 1 October 1989, p D3.
7. Jo Ann Kwong, *Market Environmentalism: Lessons for Hong Kong* (Shatin, Hong Kong: Chinese University Press, 1990).
8. *Ibid*, p 65-6.
9. Emissions charges might also benefit the poor. A poor car owner might find paying an emissions charge much cheaper than paying to have his car's emissions system totally revamped in order to meet some arbitrarily set standard.
10. For a critical appraisal of Bush's alternative fuels plan, see Warren Brooks, 'Sinful fuels trap set to snare Bush?' *Washington Times*, 24 July 1989.
11. For a review of the Bush proposal, see Kent Jeffreys, 'Two Cheers for Bush's Clean Air Plan', *The Heritage Foundation Background* (No 718), 10 July 1989. For a market-oriented cost/benefit analysis of ozone reduction programmes in the United States, see Kenneth Chilton and Anne Sholts, *Battling Smog: A Plan for Action* (St Louis: Centre for the Study of American Business, 1989).
12. Wirth and Heinz, *op cit*.
13. *Ibid*, pp 48-9, 55.
14. *Ibid*, pp 60-1, 64-5. For a good review see John Hood, 'Environmentalism Corners the Market', *Reason*, March 1989, p 18.

15. For a superb article explaining how subsidies to agriculture have created the western US water crisis, see Marc Beauchamp, 'Whiskey's for drinking, water's for fighting over', *Forbes*, 24 July 1989, pp 74-5.
16. See Terry Anderson, ed, *Water Rights: Scarce Resource Allocation, Bureaucracy, and the Environment* (Cambridge: Ballinger Publishing Company, 1983). Also, see Ronald N Johnson, Micha Gisser, and Michael Werner, 'The Definition Of A Surface Water Right And Transferability', *The Journal of Law and Economics*, October 1981, pp 273-88, and H Stuart Burgess and James P Quirk, 'Water Law, Water Transfers, And Economic Efficiency: The Colorado River', *The Journal of Law and Economics*, 23 (1980), pp 111-34. Finally, for a discussion of current efforts to establish a market in water resources, see Carl Nolte, 'Letting Market Forces Settle Who Gets Water', *San Francisco Chronicle*, 22 June 1989, section A, p 2.
17. David Fractor, 'Property Rights and Groundwater Management', in John Baden and Richard Stroup, *Natural Resources: Bureaucratic Myths and Environmental Management* (Cambridge: Ballinger Publishing Company, 1983), pp 69-83.
18. Junior rights holders are those who were the last to begin using an underground water source. When the water supply is low, junior rights holders are often shut out. This problem is especially prevalent under the so-called 'appropriation doctrine', which is commonplace in the West. (*Ibid*, p 74).
19. *Ibid*, p 76.
20. *Ibid*, pp 76-7.
21. *Ibid*, pp 80-1.
22. National Metering Trials, *Second Interim Report*, July 1990.
23. Severn Trent Customer Services Committee.
24. Donald R Denman, *Markets under the Sea?* (London: Institute of Economic Affairs, 1984).
25. *Ibid*, p 31.
26. Declared by the UN on Dec 17, 1970, and reiterated (in spirit) by the UN Charter of Economic Rights and Duties of States in 1974 and by the Law of the Sea Convention. (*Ibid*, p 34).
27. *Ibid*, pp 36-7. Although 159 nations signed the United Nations Convention on the Law of the Sea (UNCLOS), only 34 of the necessary 60 nations had ratified the document as of 1987. The United States, Britain, and West Germany in particular refused to ratify UNCLOS because of the immense power the convention would give the ISA, especially in the area of seabed mining. See Markus Schwabe, 'United Nations: At Seabed', *World Press Review*, October 1987, p 44. and Charles Horner, 'Two More If By Sea', *The American Spectator*, August 1990, pp 15.7.
28. Denman, *op cit*, pp 51-6.
29. *Ibid*, p 68.

30. *Ibid*, pp 64-5.
31. Matt Ridley, 'The Vanishing Jungle: Ecologists make friends with economists', *The Economist*, 15 October 1988, pp 25-6.
32. Jane Shaw, 'Private Property Rights: Hope for the Environment', *Liberty*, November 1988, pp 55-7, and 'Private Property Rights and the Environment: Two Views', *The Freeman*, January 1989, pp 39-40.
33. *Ibid*, p 40. For an overview of the Brazilian government's environmentally damaging programmes, see H Binswanger, 'Brazilian Policies that Encourage Deforestation in the Amazon', Department of Environment Working Paper No 16, World Bank, April 1989.
34. Nicholas Elliott, 'Subsidising Deforestation' (London: Libertarian Alliance *Economic Notes Number 30*, 1990).
35. *Ibid*, p 40. In response to international criticism, the Brazilian government began to institute a system of command-based regulations to slow deforestation. See Ivo Dawnay, 'Brazil launches programme to protect Amazon', *Financial Times*, 8 March 1989.
36. 'Empires of the Chainsaws', *The Economist*, 10 August 1991, p 52.
37. *Ibid*.
38. Similar problems of government-induced deforestation have arisen in Ghana. See William Keeling, 'Forests pay as Ghana loses out', *Financial Times*, 8 February 1989. Another interesting facet of the Brazilian deforestation problem is the role of the American government's agricultural programme. As Karl Zinsmeister notes in a recent article, 'by buying up (American) crops at artificially high prices, the (American) government sheltered foreign growers from US competition. Not surprisingly, a lot of marginal land around the globe that never would have been farmed under free markets suddenly came into production' ('Bitter Harvest', *Reason*, November 1989, p 29). In Brazil, much of this 'marginal land' is rainforest; American agricultural policy makes deforestation unusually lucrative.
39. 'Trees Don't Grow on Money', *The Economist*, 10 August 1991, p11.
40. Barry Bracewell-Milnes, *Caring for the Countryside: Public Dependence on Private Interest* (London: Social Affairs Unit, 1987).

NOTES TO CHAPTER SIX

1. For a discussion of steps that could be taken to make rules-based environmental policy reform palatable to industry, see Donald N Dewees, 'Instrument Choice in Environmental Policy', *Economic Inquiry*, 21 (1983), pp 53-71.
2. See, for instance, John Hospers, 'Liberty and Ecology', *Liberty*, September 1988, pp 23-31, and 'Property Population, and the Environment', *Liberty*, January 1989, pp 46-9.