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Briefing papers on key issues in environmental economics

The Nature of Economic Instruments

A Brief Overview

EDWARD B. BARBIER

IIED
INTERNATIONAL INSTITUTE FOR ENVIRONMENT AND DEVELOPMENT

IIED/UCL LONDON ENVIRONMENTAL ECONOMICS CENTRE

THE NATURE OF ECONOMIC INSTRUMENTS

A BRIEF OVERVIEW

EDWARD B BARBIER

London Environmental Economics Centre

Gatekeeper Series

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GATEKEEPER SERIES

This **Gatekeeper Series** is produced by the London Environmental Economics Centre (LEEC). The Centre was established in 1988 and is a joint venture by the International Institute for Environment and Development (IIED) and University College London (UCL). Its aims are the furtherance of policy relevant research in the field of environmental and natural resource economics, particularly in the context of developing countries.

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The Nature of Economic Instruments
A Brief Overview

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Introduction

The need for environmental policy instruments arises when markets fail to exist for environmental goods and services, or fail to fully reflect their values. Common factors behind such *market failures* are the lack of well-defined property rights, imperfect competition, imperfect information (including the presence of risk and uncertainty) and the prevalence of 'spillover' effects (e.g. environmental 'externalities'). Government interventions in the form of pricing policies, regulations, public investment programmes, fiscal and monetary policies can also contribute to or even cause market failure in environmental goods and services. *Policy failures* may also occur if governments do not provide the proper regulatory and institutional framework, i.e. establishing secure property rights, credit and lending institutions, contractual enforcement, public administration, etc., that allow such markets to exist or perform adequately.

Market and policy failures distort the economic incentives for natural resource and environmental management. As a consequence, the economic damages from resource depletion and pollution are often not fully borne by private decision-makers (e.g., firms and households) whose activities are the source of these damages. In other words, the *social costs* of environmental degradation will be greater than the *private costs*, and 'excessive' resource depletion and pollution will ensue.

In such circumstances, environmental policy instruments do have a role to play in reducing the excessive environmental degradation - provided that the benefits of reducing degradation exceed the costs of implementing and enforcing the policy (including any inadvertent side effects or distortions). Precisely because they have the potential to be *cost-effective*, or *efficient*, economic instruments for natural resource and environmental management are receiving increased attention, and even increasing implementation, in both developed and developing countries.

Economic Instruments and Incentives

Economic, or *market-based*, instruments do not directly control or restrict activities that degrade the environment. Rather, they create the economic incentives for individuals to choose

freely to modify or reduce their activities, thus indirectly producing an environmental improvement. Economic instruments can be narrowly or broadly categorized.

The 'narrowest' classification would include all policy measures that explicitly affect private costs and benefits so that any unaccounted social costs (and benefits) of environmental degradation can be 'internalized' to ensure the desired environmental improvement. There are five general categories of this type of instrument:

i. *Charges (taxes), fees or other 'additional' prices to be paid for the social costs arising from environmental damages. Examples would include effluent* charges on sulphur dioxide emissions, tax differentiation between leaded and unleaded petrol, user charges for public waste disposal, depletion taxes on mineral exploitation and stumpage fees for timber extraction.

ii. *Subsidies* to assist individuals in altering activities or conforming to environmental standards. Examples include subsidies for the development and adoption of 'clean' technologies, tax allowances for energy conservation, soft loans for erosion control investments and price supports for paper recycling industries.

iii. *Deposit/refund or fee/rebate systems*, where a surcharge is levied on the price of products leading to resource depletion or pollution which is then refunded if the product (or its residuals) are 'recycled' or if the depleted resource is 'restored'. Examples include deposit/refund schemes for glass bottles, aluminum cans and other containers and reforestation rebates on timber stumpage fees.

iv. *Tradeable or marketable permits*, where rights to discharge pollution or exploit resources can be exchanged, either through a free or controlled 'permit' market. Examples include tradeable permits for greenhouse gas emissions, marketable quotas for fish harvesting, tradeable depletion rights to mineral concessions and marketable discharge permits for water-borne effluents.

v. *Compensatory incentives*, which are similar to subsidies in that markets or financial inducements are created for certain individuals or groups who either disproportionately bear the risk or costs of environmental improvement or who possess 'unique' environmental assets. Examples include compensatory financing of 'environmentally-friendly' technology transfer to developing countries for compliance with international environmental agreements, debt-for-nature swaps involving biologically diverse tropical forests and increased heating allowances for the poor and aged to compensate for energy or carbon taxes.

Broader definitions of economic instruments would include certain *enforcement incentives* for compliance with environmental regulations, such as performance bonds that are paid in advance and refunded when compliance is assured, non-compliance fines that are levied when regulations are violated, and assigning legal liability for the costs of environmental degradation (Opschoor and Vos, 1989). Other authors extend further the definition of economic instruments to include the removal of subsidies and other public policy interventions that distort the *private* costs of resource use and pollution discharge (Panayotou, 1990 and Pearce, 1990). Such distortions are particularly prevalent in developing countries, where public policies frequently reduce the direct costs to individuals of exploiting or converting natural resources and of using the environment as a waste 'sink'. Finally, institutional reforms such as the improvement or establishment of property right regimes, legal titling, environmental sanctions, contract enforcement and so forth are sometimes categorizes as 'economic' instruments in that they assist or even establish markets for environmental goods and services (Panayotou, 1990).

This paper will restrict its use of the term *economic instrument* to the narrow definition; i.e., the five categories of policy instruments listed above. Although excluded by such a narrow classification, regulatory enforcement incentives, public policy reform and institutional reform are equally - if not more - important in providing the necessary *economic incentives* for natural resource and environmental management.

Regulatory and Other Policy Instruments

In complete contrast to economic instruments, *regulatory*, or *direct control*, instruments involve the direct limitation or reduction of activities that degrade the environment, in accordance with some legislated or agreed standard. Examples include quotas or bans on renewable resource harvesting, restrictions on air pollution emissions, controls on hazardous waste transport and dumping, zoning laws and ambient water quality standards. Such controls are usually mandatory and enforceable through litigation, fines/penalties, revocation of licenses or other judicial or administrative sanctions.

Another, related category of policy instruments include *self-regulation*, *voluntary regulation* and *negotiated agreements*. Self-regulation and voluntary regulation are often established after consultation with government or other social groups, but are left to polluters or resource exploiters to implement, and in the case of self-regulation, to monitor and enforce as well. Regular environmental audits and other forms of information disclosure may also be required. Negotiated agreements to limit pollution and resource depletion are rare. An interesting example is the International Tropical Timber Agreement, which has provided a forum for consumers, producers and traders to discuss the best means to encourage sustainable management of the world's remaining tropical production forests.

Criteria in the Selection of Policy Instruments

An important criterion in the selection of an environmental policy instrument is its *cost-effectiveness*, or *economic efficiency*, in achieving the desired improvement in environmental quality or resources. Obviously, an instrument cannot be cost-effective if it is not first appropriate to the environmental improvement at hand. For example, as discovered in Indonesia, the implementation of a reforestation tax/rebate scheme will fail in its objectives if it concession leases are so short that timber companies have no incentive to replant stands (Barbier, Burgess and Markandya, 1991). Similarly, tradeable permits for extremely toxic discharges may be less appropriate than an outright ban on emissions or user charges to pay for de-toxification and disposal.

If they are appropriate, the potential cost-effectiveness of economic instruments makes them attractive alternatives to regulatory controls. Regulatory instruments require the central authority to determine the best course of action, whereas economic instruments de-centralize much of the decision-making to the single firm or household, who typically has better information for determining the appropriate individual response to given economic conditions. For example, studies routinely indicate that the costs of direct control of air pollution are 2 to over 20 times more costly than economic instruments (Tietenberg, 1990). In addition, economic instruments provide cost incentives to adopt 'cleaner' technologies and 'alternative' resource inputs and processes, or to develop such improvements with time.

However, there are important qualifications to the inherent attractiveness of economic instruments:

i. important criteria other than cost-effectiveness may be used to evaluate and select environmental policy instruments;

ii. under certain conditions (e.g., the presence of uncertainty, threshold effects, pollution 'mixes', etc.) the cost savings from employing economic instead of regulatory instruments may be minimal, or even negative;

iii. economic instruments are often used in conjunction with regulatory instruments, and in some instances, a 'mix' of instruments may be the most cost-effective approach.

It is worth discussing the first point briefly. The other two points are the subject of the next section.

Certain economic instruments, such as taxes and fees, may have the deliberate or unintended effect of raising revenue. In many instances, this may be the principal reason for employing the instrument. For example, a 1987 survey of 37 charge systems in 14 OECD countries found that most served the *financial* objective

of raising revenues rather than the *incentive* objective of reducing pollution (Opschoor and Vos, 1989). Although raising funds may indirectly contribute to environmental and natural resource management programmes, charges and fines levied for this purpose will generally have limited incentive effects. Yet the financial objective may be extremely important, especially in developing countries where budgetary constraints constrain the financing of new environmental programmes (Anderson, 1990). Even in OECD countries where fiscal considerations are becoming increasingly important, the use of revenue-raising instruments is more frequently considered (Tietenberg, 1991).

However, in practice, direct controls have been traditionally preferred as the main environmental policy instruments, which suggest that criteria other than cost-effectiveness or revenue-raising have been prevalent. The reasons for this preference are (Bohm and Russell, 1985; Opschoor and Vos, 1989; Pearce, 1990):

i. *Policymakers* seem to prefer regulation because:

   a. a 'regulative' tradition exists such that authorities are more familiar with the direct control approach, whereas switching to economic instruments implies additional information requirements, higher initial administrative costs, bureaucratic opposition and more complex or at least unfamiliar processes;

   b. the effects of regulation are more certain, whereas the revenue and incentive effects of charges and other economic instruments are seen as too uncertain;

   c. charges and other economic instruments are perceived as having undesirable impacts on inflation, income distribution and international competitiveness.

ii. *Firms* and *individuals* seems to prefer regulation because:

   a. there is a fear that charges and other economic instruments might be additional to compliance costs or that such instruments might be 'misused' for financial rather than incentive purposes;

   b. they are also more familiar with the 'regulative' tradition, and can influence this process better through negotiation;

   c. there is a 'risk aversion' to instruments which have variable outcomes that may be difficult to predict or plan for, to the extent that even stricter, but more certain, direct controls are preferred.

Added to these concerns is the growing influence of 'supra-national' environmental regulation (e.g. the EEC) and the negotiation process of international environmental agreements. Although it is expressing greater interest in the use of economic instruments, the EEC also must overcome an in-built 'regulative'

tradition and concerns similar to those of national governments over economic instruments. Moreover, the drive to 'harmonize' environmental regulations and taxation across the EEC may mean the adoption of uniform standards, charges and permit systems across countries with markedly differing pollution abatement costs. Finally, the negotiation process of incorporating economic instruments or even differentiated standards into international environmental agreements may be extremely complex and costs compared to negotiating uniform global or regional standards. The exception may be the use of compensatory financing, say, for developing countries, which is necessary to secure the agreement in the first place (Barrett, 1990).

The Relative Cost-Effectiveness of Economic Instruments

The cost-effectiveness of economic instruments depends on a large part on their ability to relate incentives to the economic damages of pollution and resource depletion, and conversely, to the economic benefits of environmental improvements. However, precisely because the effects occur 'externally' to markets, the economic impacts of environmental degradation are difficult to measure and value. For example, the economic damages associated with pollution may vary depending on geographical location, the combined effects of pollution 'mixes', seasonal variations and other factors affecting 'critical loading' of assimilative capacity. To go one step further and measure the various impacts on economic activities and welfare is often difficult. Similarly, to value the full costs of resource degradation and depletion often involves complex and difficult calculations of the 'user' costs of forgone future income from irreversible loss of the resource today, the 'external' impacts on ecosystems and economic activity, and the loss of 'unique' or 'intrinsically' valuable species and environments.

Under conditions of uncertainty, different environmental policy instruments are preferable under different conditions. With economic instruments, the uncertainty usually manifests itself in terms of uncertainty over the *reduction* in environmental damage, whereas with regulatory controls the uncertainty is over the *costs* of reduction. Although difficult to generalize, under uncertainty regulatory instruments will tend to produce too little pollution and resource depletion, with a greater share of the economic burden being borne by producers and resource users, whereas economic instruments tend to yield too much pollution and resource depletion, with the burden shifted mainly to consumers and 'victims'. If there are undesirable but unknown 'threshold' effects associated with increased environmental degradation, then regulatory control will be preferred. Similarly, if the damages are uncertain by appear to rise slowly as environmental degradation increases (relative to the decline in benefits), then direct controls will be preferable, as they will minimize expected efficiency losses.

In many instances, policy 'mixes' of regulatory and economic instruments may be the best control approach to pursue. The

risks of having too little or too much environmental degradation can be minimized; for example, the economic instrument can improve cost effectiveness or recover administrative costs whereas the standard can ensure that the desired control of degradation occurs.

Conclusion: A Plethora of Instruments

A recent review of economic instruments in OECD countries indicates that their use is increasing rapidly (OECD, 1991). As displayed in Figure 1, since the 1987 survey mentioned above, the number of charge systems adopted or under consideration has almost trebled, and their implementation has now spread to around 21 countries. Moreover, more charges are being adopted or considered for their incentive effect rather than just for revenue-raising purposes. Economic instruments are being targeted for new areas of environmental control, such as CO_2 abatement and reducing fertilizer use. Sometimes the results are surprising in their effectiveness. In Austria, a levy on fertilizers was introduced in 1986 at a very low rate. In addition, it was believed that fertilizer use was fairly unresponsive to price changes. Despite this, the tax has resulted in a drop of fertilizer use by one fifth. A further rise in the charge is now being considered (OECD, 1991).

Despite their increased publicity, experiments in tradeable permits (e.g., emissions trading) are still largely being confined to the United States. A recent review of the experience there suggests that emissions trading works especially well for uniformly mixed pollutants, can be integrated more smoothly into an existing regulatory framework, offers flexibility for activities that have high costs of control and has an element of 'economies of scale' as larger trading areas offer greater cost of control reductions. On the negative side, emissions trading has high transaction and administrative costs and places more importance on operating permits and emissions inventories than other policy instruments (Tietenberg, 1990). As more experience and familiarity with tradeable permits is gained, their use is expected to increase.

There has also been development of more flexible, quasi-economic instruments, again mainly (but not exclusively) in the United States. For example, private citizens are now authorized to seek injunctions, and in some cases penalties, against firms violating the terms of their operating permits. At the same time, civil and criminal penalties and fines have been imposed more frequently on violators and the size of the penalties have increased, indicating a more variable 'charge' approach. Although private enforcement is only cost-effective when the underlying environmental standard is efficient in the first place, the value of private action is important when public enforcement is not very effective. Moreover, combining private action with an economic instrument, such as emissions trading, tends to encourage compliance with the overall standards, as well

Figure 1.

CHARGE SYSTEMS IN USE (October 1990)

	Effluent							
Country	Air	Water	Waste	Noise	User	Product	Administrative	Tax Differentiation
Australia		X	X		X		X	
Austria		(X)	X			X		X
Belgium	(X)	X	X		X		X	X
Canada					X	X		X
Denmark			X		X	X	X	X
Finland	(X)	(X)	(X)			X	X	X
France	X	X	(X)		X	X		
Germany		X	(X)	X	X	X	X	(X)
Greece	(X)					X		X
Italy		X			X	X		
Japan	X			X				
Nether-lands		X	X	X	X	X	X	X
New Zealand						X(1)		
Norway					X	X	X	X
Portugal	X	X	X		X	X		X
Spain			X		X		X	
Sweden	X(2)				X	X	X	X
Switzer-land	(X)			X	X	(X)	X	
Turkey			X					
United Kingdom		X		X	X		X	X
United States				X	X	X	X	

X = Applied (X) = Under consideration
(1) = Will be introduced at 1.1.1992 (2) = Will be introduced at 1.1.1992
Source: OECD

as encouraging the high abatement cost firms to trade (Tietenberg, 1991).

In the future, we can expect a greater policy 'mix' of instruments, with economic instruments playing an increasing part, either on their own or in combination with regulatory instruments.

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BOOKS

Edward B. Barbier

Economics, Natural-Resource Scarcity and Development: Conventional and Alternative Views, Earthscan, London, 1989 (paperback £15.00)

The history of environmental and resource economics is reviewed; then using insights from environmentalism, ecology and thermodynamics, Barbier begins the construction of a new economic approach to the use of natural resources and particularly to the problem of environmental degradation. With examples from the global greenhouse effect, Amazonian deforestation and upland degradation on Java, Barbier develops a major theoretical advance and shows how it can be applied. This book breaks new ground in the search for an economics of sustainable development.

David W. Pearce, Anil Markandya and Edward B. Barbier

Blueprint for a Green Economy, Earthscan, London, 1989 (paperback £8.95)

This book was initially prepared as a report to the Department of Environment, as part of the response by the government of the United Kingdom to the Brundtland Report, *Our Common Future*. The government stated that: '...the UK fully intends to continue building on this approach (environmental improvement) and further to develop policies consistent with the concept of sustainable development.' The book attempts to assist that process.

Edward B. Barbier, Joanne C. Burgess, Timothy M. Swanson and David W. Pearce

Elephants, Economics and Ivory, Earthscan, London, 1990 (paperback £10.95)

The dramatic decline in elephant numbers in most of Africa has been largely attributed to the illegal harvesting of ivory. The recent decision to ban all trade in ivory is intended to save the elephant. This book examines the ivory trade, its regulation and its implications for elephant management from an economic perspective. The authors' preferred option is for a very limited trade in ivory, designed to maintain the incentive for sustainable management in the southern African countries and to encourage other countries to follow suit.

Gordon R. Conway and Edward B. Barbier
After the Green Revolution: Sustainable Agriculture for Development, Earthscan Pub. Ltd., London, 1990 (paperback £10.95)

The Green Revolution has successfully improved agricultural productivity in many parts of the developing world. But these successes may be limited to specific favourable agro-ecological and economic conditions. This book discusses how more sustainable and equitable forms of agricultural development need to be promoted. The key is developing appropriate techniques and participatory approaches at the local level, advocating complementary policy reforms at the national level and working within the constraints imposed by the international economic system.

David W. Pearce, Edward B. Barbier and Anil Markandya
Sustainable Development: Economics and Environment in the Third World, London and Earthscan Pub. Ltd., London, 1990 (paperback £11.95)

The authors elaborate on the concept of sustainable development and illustrate how environmental economics can be applied to the developing world. Beginning with an overview of the concept of sustainable development, the authors indicate its implications for discounting and economic appraisal. Case studies on natural resource economics and management issues are drawn from Indonesia, Sudan, Botswana, Nepal and the Amazon.

David W. Pearce and R. Kerry Turner
** *Economics of Natural Resources and the Environment*, Harvester-Wheatsheaf, London, 1990.

This textbook covers the elements of environmental economics in theory and in application. It is aimed at undergraduates and includes chapters on sustainable development, environmental ethics, pollution taxes and permits, environmental policy in the West and East, recycling, and optimal resource use.

David W. Pearce, Edward B. Barbier, Anil Markandya, Scott Barrett, R. Kerry Turner and Timothy M. Swanson
Blueprint 2: Greening the World Economy, Earthscan Pub. Ltd., London, 1991 (paperback £8.95)

Following the success of *Blueprint for a Green Economy*, LEEC has turned its attention to global environmental threats. The book reviews the role of economics in analyzing global resources such as climate, ozone and biodiversity, and considers economic policy options to address such problems as global climate change, ozone depletion and tropical deforestation.

E.B. Barbier and T.M Swanson (eds.)
Economics for the Wilds: Wildlife Wildlands, Diversity and Development, Earthscan Pub. Ltd., London, 1992 (paperback £12.95).

This collection of essays address the key issues of the economic role of natural habitat and wildlife utilization in development. The book argues that this role is significant, and composes such benefits as wildlife and wildland products, ecotourism, community-based wildlife development, environmental services and the conservation of biodiversity.

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