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ECONOMIC INSTRUMENTS FOR ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT

by

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Preface and Acknowledgements

The plea for a sustainable development path and the need to cope with transboundary and global pollution issues requires the development of new and effective policies in which economic instruments have an important role to play.

The importance of economic instruments for environmental policy is emphasized in both the Rio Declaration and Agenda 21, where it was stressed that the use of economic instruments represents a tool for national authorities to promote the internalization of environmental costs and to apply the polluter-pays principle in the most efficient manner. They provide a means of enhancing the capacity of governments to deal with environmental and development issues in a cost effective manner, promoting technological innovation, influencing consumption and production patterns, as well as providing an important source of funding.

This volume presents a comprehensive state-of-the-art on economic instruments for environmental management and sustainable development and reviews the experience of developed countries and its relevance to developing countries. It documents the experience of developing countries in the use of economic instruments in environmental management. It attempts to delineate the modalities for introducing economic instruments in developing countries and countries in transition and human resource requirements and financial implications. Finally it attempts to establish a strategy for successfully introducing economic instruments in developing countries. The document makes a successful contribution to the field of economic instruments and shows that even in poor countries the introduction of economic instruments is a bankable project.

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CHAPTER 1 INTRODUCTION

Environmental policy and management, as originated in developed countries, is divorced from economic policy and sustainable development. Having achieved high levels of economic development with unrestricted access to resources and unhindered by environmental concerns, developed countries sought to protect their environment and ultimately their quality of life from the side effects of economic activity. Effects such as air and water pollution, hazardous waste, and more recently, global climate change. In that context, environmental management was seen as a necessary restriction or regulation of economic activity to contain environmental damage within acceptable bounds. Therefore, it appeared reasonable to set environmental policy independent of economic policy—as a set of quantity constraints such as emission standards on the level of pollutants and maximum allowable harvests to stem the depletion of resources. The cost of doing so was thought to be low relative to the high income levels already achieved in these countries.

The experience with standards-driven environmental policy in developed countries over the past decades suggests that the mandated environmental standards and technologies acted as a drag on economic growth and costs have been far greater than expected, though still quite affordable given their high incomes (see Jorgenson and Wilcoxen, 1990). This realization has induced developed countries to seek more efficient or at least less costly means of achieving the same level of environmental protection through the use of economic or market-based instruments.

For developing countries and the transitional economies of Eastern Europe and the former Soviet Union, the divorce of environmental policy from economic policy and from efforts to achieve sustainable development is meaningless and potentially disastrous both economically and environmentally. Where standards of living are unacceptably low, where poverty is a major source and victim of environmental degradation, where natural resource exploitation is the engine of growth, where formerly planned economies struggle to restructure and recover, imposing constraints on economic activity to protect the environment for its own sake rather than as an input in sustainable development has very limited appeal. Under these conditions, environmental policy cannot be divorced from economic policy and development strategy. Moreover, under conditions of (desired) rapid economic growth and massive structural change, mandated standards and technologies that allow no room for differential response and adjustment to rapidly changing circumstances are both very costly and difficult to enforce. Command-and-controls require the generous use of resources such as capital, government revenue, management skills, administrative and enforcement capabilities, the very factors that are in scarce supply in developing and reforming economies.

The challenge for developing countries and transitional economies is to identify and adopt instruments that integrate environmental and economic policy and that are parsimonious in their use of scarce development and management resources; instruments that allow differential response by economic units and adjust flexibly to changing circumstances. The search for instruments of environmental management in developing countries and transitional economies is a search for instruments of sustainable development. Economic instruments meet most of these conditions and are uniquely suited for the integration of environmental and economic policy and can be designed to advance sustainable development.

Despite their many advantages, economic instruments are not widely used and their introduction faces many obstacles. First, the experience with economic instruments is very limited and much of it comes from developed countries which have used them primarily as sources of government revenues, much less as incentives to alter behavior, and not at all as instruments for the integration of economic and environmental policy or as vehicles of sustainable development. Given the very different conditions prevailing in developing countries, the developed country experience is not readily transferable; it does, however, contain useful lessons for both developing countries and transitional economies.

Second, developing countries themselves have been experimenting with economic instruments for some time and although this experience is more relevant, it is anecdotal and largely undocumented. It is also important to note that developing countries are a very heterogeneous group, both in terms of the stage of economic and political development and in terms of ecological conditions. These differences limit the direct transfer of developing country experience (e.g., from Southeast Asia to sub-Saharan Africa). Nevertheless, the fact that a dissimilar group of developing countries has been able to adopt and adapt economic instruments for environmental management bodes well for the introduction of these instruments elsewhere in the developing world. Furthermore, traditional societies

have a wealth of incentive-based instruments for resource management such as communal property rights and customary use rights that provide a cultural basis and insights for the introduction of modern economic instruments.

However, the slate for the introduction of economic instruments is far from clear. There are already in place command and control regulations dictating pollution and resource depletion standards and specific technologies. Their complete abandonment and replacement by economic instruments is out of the question for reasons that range from economic disruption to political economy. The most promising entry points for economic instruments are in answering concerns about the efficiency and flexibility of existing regulations, the need for fiscal revenues, and in the search for instruments to reconcile economic and environmental policy and to promote sustainable development. A good place to start is with the gradual introduction of selected economic instruments adapted to local conditions, to lend flexibility, financial support, and increased efficiency to the existing regulatory regimes.

The objective of this monograph is sevenfold: (a) to explore the analytical foundations as well as the scope and role of economic instruments in environmental management (Chapters 2 and 3); (b) to review the experience of developed countries and assess its relevance to developing countries (Chapter 4); (c) to document the experience of the developing countries which have applied economic instruments to the management of different resource and environment sectors (Chapter 5); (d) to explore the applicability of economic instruments to the protection of the global commons and their implications for developing countries (Chapter 6); (e) to analyze the special circumstances of developing countries and the way in which they could influence the applicability and selection of economic instruments (Chapter 7); (f) to delineate the modalities for introducing economic instruments in developing countries and transitional economies and to assess the institutional and human resource requirements and financial implications (Chapter 8); and (g) to formulate a strategy for the successful introduction of economic instruments in developing countries.

CHAPTER 2 ANALYTICAL FRAMEWORK AND THE ROLE AND SCOPE OF ECONOMIC INSTRUMENTS

A combination of institutional, market and policy failures results in the underpricing of scarce natural resources and environmental assets, which in turn translates into an underpricing of resource-based and environment-intensive goods and services. Institutional failures such as the absence of secure property rights, market failures such as environmental externalities, and policy failures such as distortionary subsidies, drive a wedge between the private and social costs of production and consumption activities. As a direct result, producers and consumers of products and services do not receive the correct signals about the true scarcity of resources they deplete or the cost of environmental damage they cause. This leads to: over-production and over-consumption of commodities that are resource-depleting and environment-polluting (See Figure 1), and under-production and under-consumption of commodities that are resource-saving and environment-friendly. Thus, the emerging pattern of economic growth and the structure of the economy is one that undermines its own resource base, and is ultimately unsustainable.

Full-Cost Pricing

Economic instruments aim to bridge the gap between private and social costs by internalizing all external costs (both depletion and pollution costs) to their sources: the producers and consumers of the resource depleting and polluting commodities. Economic instruments aim to institute full cost pricing by costing and charging full scarcity cost for resource depletion and full damage cost for environmental degradation (See Figure 1). Full cost pricing is given by the formula:

P = MPC + MUC + MEC

Where P = price

MPC = marginal (or incremental) production cost

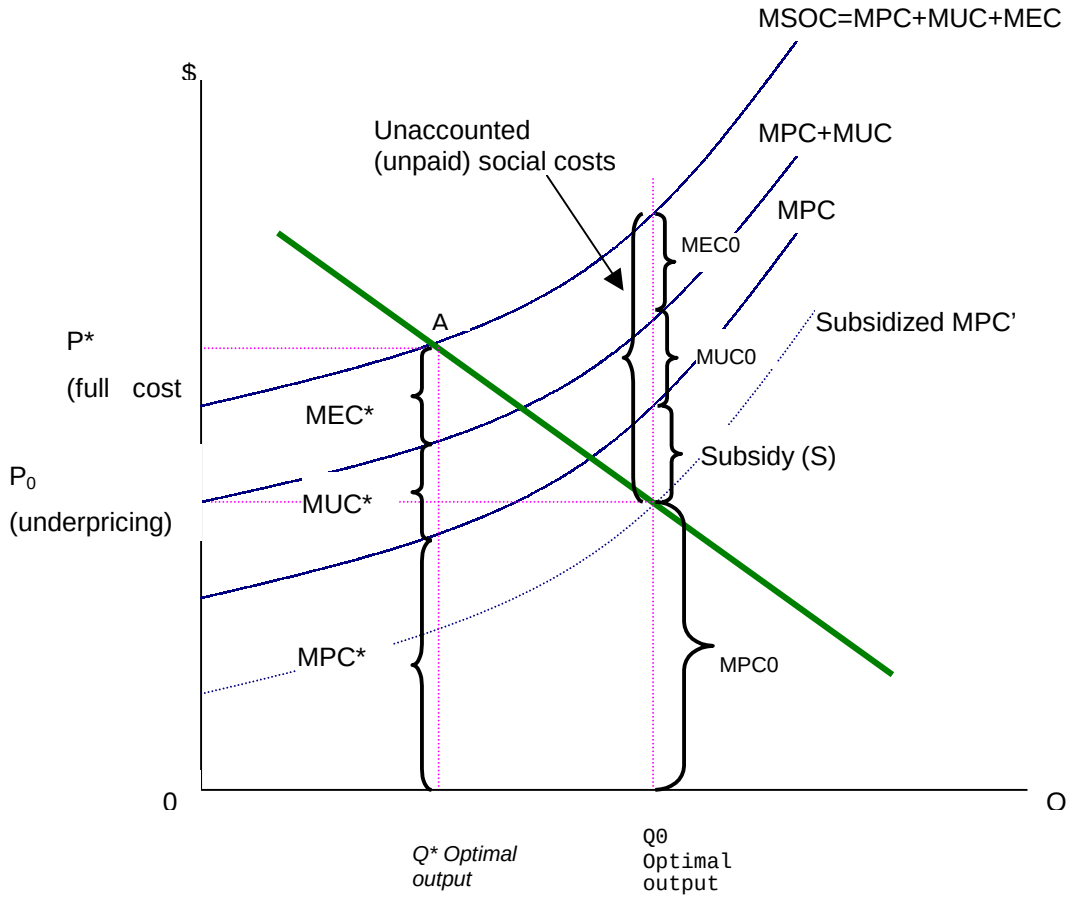
MUC = marginal user (or depletion) cost

MEC = marginal environmental (or damage) cost.

Policy failures such as subsidies, reduce marginal production costs (the cost of capital, labor, energy, and materials) below the social opportunity costs, (that is, the true cost of these factors of production to society), encouraging inefficient and excessive use of subsidized inputs. *Institutional failures* such

as open access and insecure tenure, reduce the user's benefits from the conservation of depletable resources and remove the marginal user (or depletion) cost from the decision-maker's calculus. The cost of depletion to the user is effectively set equal to zero even though the cost of depletion to society is high and rising. As a result the resource is undervalued, and used excessively and inefficiently. Resource-based goods and services are thereby underpriced and over-consumed. *Market failures* such as environmental externalities (and public goods), leave important social costs (and benefits) outside the producers' and consumers' decision calculus. The lack of market prices for environmental services effectively sets the marginal environmental cost (that is, the cost to society from the diminution of these services) equal to zero from the individual producer's or consumer's perspective. This becomes one more source of underpricing of environmentally damaging commodities and overpricing of environmentally friendly commodities. The latter is not only relatively more costly but also absolutely more costly because of the loss of resources and scale economies to highly polluting commodities.

Figure 1. Unaccounted social costs ($S+MUC_0+MEC_0$), underpricing and overproduction (P_0, Q_0) vs. internalization of external costs, full cost pricing and optimal production (P^*, Q^*); the role of economic instruments in internalizing external costs ($MUC^* + MEC^*$)



At A: P^* = MSOC≡MPC + MUC + MEC where P^* = optimal price, MSOC = marginal social opportunity cost, MPC = marginal production cost; MUC = marginal user (or depletion) cost; MEC = marginal environmental (damage) cost.

Q^* = optimal output; resources freed by the reduction of the polluting output from Q^0 down to Q^* move to other products with lower social costs (e.g., resource saving and environment-friendly).

MPC^* internalized by removal of distortionary subsidies.

MUC^* internalized through secure property rights (assuming no discrepency between private and social discount rates; if such discrepancy exists output taxes or tradeable production quotas can be used for further correction).

MEC^* internalized through taxes, charges, tradeable permits or other economic instruments (optimal tax = optimal price of permit = MEC^*).

Internalizing External Costs Through Economic Instruments

Economic instruments for environmental management such as the removal of distortionary subsidies, secure property rights, pollution taxes, user charges, tradeable emission permits, and refundable deposits aim to correct these failures, reinstate full-cost pricing, and bring about a realignment of resource allocation with society's objectives and interests—a necessary condition for sustainable development. The importance of the internalization of environmental costs in sustainable development and the critical role of economic instruments in bringing it about was duly recognized by the United Nations Conference on Environment and Development in Rio de Janeiro, June 1992. Principle 16 of the Rio Declaration states: “National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution with due regard to public interest and without distorting international trade and investment (UN 1992).”

Economic Instruments are ideally situated for reconciling environmental concerns with development needs and integrating environmental and economic policy by virtue of their a) market correction quality, b) efficiency or cost-minimization objective, c) flexibility in accommodating heterogeneity, and d) adjustability to changing circumstances.

Indeed, economic instruments cannot only be used to reduce the apparent environmental development conflict but, if properly designed and implemented, can actually make economic development a vehicle of environmental protection and vice versa. Economic instruments can be used to provide the kinds of signals concerning resource scarcity and environmental damage that induce efficient resource use and minimization of waste, which are needed to make sustainable development possible.

The key to the promise of economic instruments is their ability to harness the power of the market and self interest and to turn these presumed adversaries of sustainable development into powerful allies. This is done not by mandated or prescribed actions, but by changing the economic incentives facing producers and consumers; by taking full advantage of their self interest and superior information at their disposal without requiring the disclosure of such information or creating large and costly bureaucracies. Economic instruments in effect transfer from bureaucrats to the market the responsibility of identifying and exploiting new and additional low cost sources of pollution control. Incentive-based systems provide the regulators with the capability to reach and control previously unregulated sources of environmental degradation. Dispersed, small scale sources, which are too costly to reach or in financial difficulty can be encouraged to control their pollution voluntarily and to sell their credits to higher cost pollution abators who will find it in their own best interest to purchase credits rather than to control their own emissions at a higher level (Titenberg, 1993). This is a major advantage for developing countries with large numbers of small scale polluters and undeveloped regulatory systems.

Efficiency, Cost Effectiveness and Equity

Another advantage of economic instruments, which is of enormous importance to both domestic and international environmental policy (and ultimately sustainable development) is a separation of the question of who controls pollution or who practices conservation from the question of who pays for it.

This makes possible the attainment of an equitable distribution of costs and benefits without sacrificing efficiency or cost effectiveness, another necessary condition for sustainable and optimal development.

Clearly, to minimize costs (to be cost effective), pollution control and resource conservation should be carried out by those who are able to do it at the lowest cost. To be efficient, no more pollution control should take place than is justified by the ensuing benefits (i.e., the pollution control should be carried out to the point where the incremental pollution control costs just equal the incremental benefits i.e., additional damages avoided. To be equitable, the cost of pollution control should be paid by those whom society has determined it is fair to do so. If the society's sense of fairness, as determined by the political process, accords the rights to a clean environment to the society at large, the users of the environment for the disposal of waste (polluters), whether producers or consumers, ought to pay the cost of pollution control and abatement. Indeed, in this case, polluters are liable not only for the cost of pollution control to socially optimal levels, but they are also liable for payment for the use of the assimilative capacity of the environment, a scarce, renewable, but depletable resource. This is known as the “polluter pays principle” and is widely accepted by most countries internationally as a fair distribution of pollution control costs. This principle is a statement about cost distribution or fairness, not about efficiency. It does not tell us who and how to control pollution, only that the costs are to be paid by the polluters. Mistakenly, polluters are thought to be the producers of goods and services; however, consumers are indeed the ultimate polluters since without demand the polluting products would not be produced. In practice, the pollution control costs are shared between producers and consumers according to the elasticity of demand for the polluting product in question. Another popular misconception is that the private sector is the most important, if not the exclusive source of pollution and environmental degradation while governments are viewed mainly in the role of environmental regulators. In reality, governments and state enterprises are themselves major sources of pollution and environmental degradation, either directly through public production, consumption, and investment or indirectly through subsidization of polluting activities and other misguided policies.

How are the pollution control costs to be allocated among polluters? Fairness here requires that the costs are allocated in proportion to the damages caused by each polluter (which are considered proportional to emissions within the same airshed or watershed) and not according to their pollution control costs. A combination of efficiency and equity (with the polluter pays principle as the operative rule of fairness) dictates that pollution within a given airshed or watershed is (a) controlled up to the point where the marginal cost of control equals the marginal benefit, (b) that the control is carried out by those who have the lowest possible pollution control cost, and (c) that the cost of pollution control is paid by those who generate the pollution in proportion to their emissions (in the first instance the producers and ultimately both producers and consumers with their relative shares determined by the elasticity of demand).

The polluter pays principle is not the only possible distributional rule. Different societies in different cases may allocate the rights to the use of the environment to the polluters in which case the operative distributional rule is the “beneficiary pays principle”. According to this principle, those who expect to benefit from pollution control or conservation are expected to pay the costs according to the benefits they expect to derive. This may sound unfair and regressive because the layman's perception of polluters is that of large, wealthy corporations and multinationals, while the affected parties are perceived to be poor and helpless. (The classic example is the Bhopal disaster in India where wealthy, multinational corporations destroyed the lives of thousands of poor Indian workers). However, there are many counter-examples of poor “polluters” and wealthy affected parties (potential beneficiaries of pollution control). Consider for example the case of upland shifting cultivators who deforest watersheds causing downstream flooding and sedimentation of irrigation and hydroelectric reservoirs that provide wealthy farmers, urban residents and industries with water and energy. Clearly in this case a “beneficiary pays principle” appears to be both fair and distributionally progressive. Again it should be made clear that, although we can generally characterize as distributionally positive or progressive, policies and instruments that favor the poor over the wealthy (help narrow income distribution inequalities), it is the particular society concerned that determines what is a “fair” or “just” distribution of costs and benefits.

Another example of the “beneficiary pays” application, which is also seen as fair and equitable, is in the conservation of the so-called global commons. It is widely accepted that the cost of biodiversity conservation and control of greenhouse gases ought to be borne by the developed countries, the major beneficiaries. Again, this does not imply that it is solely the developed countries who would actually conserve their biodiversity or control their greenhouse gas emissions. Efficiency requires that

biodiversity conservation and CO_2 emissions reductions and sinks take place where they can be achieved at the minimum cost, which may be the developing countries. Fairness or equity under the beneficiary pays principle requires that the cost of biodiversity conservation and CO_2 emissions be borne largely by the developed countries.

It is also possible that the property rights to environmental assets (or to their services) are divided between polluters and affected parties (potential beneficiaries of pollution control). For example, polluters may be entitled to use the environment for the disposal of waste, free of charge, up to the socially optimal level of pollution; beyond this level polluters are subject to a pollution tax or charge, the implication being that the society at large owns the right to the environment beyond this level.

Economic Instruments as a Source of Revenue

Last but certainly not least, economic instruments raise large amounts of revenue that can be spent either on public goods that improve environmental quality or can be used to reduce distortionary taxes such as income taxes, which reduce the incentive for work, or sale taxes which distort consumption decisions. As the focus of the present study is on economic instruments as incentive systems, their financing function is addressed in a companion study (Panayotou, forthcoming).

CHAPTER 3 ECONOMIC INSTRUMENTS TYPOLOGY, ADVANTAGES, AND LIMITATIONS

The set of economic instruments available for implementing an economic incentives approach to natural resource management and environmental protection spans a wide range of options and possibilities, and the potential permutations and combinations are virtually limitless. Any instrument that aims to induce a change in behavior of economic agents by internalizing environmental or depletion cost through a change in the incentive structure that these agents face (rather than mandating a standard or a technology) qualifies as an economic instrument. Different instruments have advantages over other instruments in different applications and circumstances, and severe limitations in others. The application and relative advantages and limitations of each type of instrument will be addressed in connection with particular sectors and sets of objectives and conditions in later chapters. In the present chapter we focus on (a) a typology and brief description of the range of economic instruments that have been actually used or proposed; (b) their general applicability in different sectors; and (c) their general advantages and limitations.

As shown in Figure 2, economic instruments may be classified into seven broad categories:

a) property rights

b) market creation

c) fiscal instruments

d) charge systems

e) financial instruments

f) liability instruments

g) performance bonds and deposit refund systems

Below we discuss each broad category of instrument and their constituent components, as outlined in Figure 2. In Figure 3 we present a matrix of economic instruments and their sectoral uses.

Property Rights

This class of instrument is based on the recognition that excessive resource depletion and environmental degradation arises from misleading price signals which result from the absence (or thinness) of markets in resource and environmental assets. To the extent that the failure of markets to emerge is due to the lack of well-defined, secure, and transferable property rights over resources (as opposed to other reasons such as high transaction cost or failure to enforce contracts), establishment of secure property rights should lead to the emergence of markets and scarcity prices for the resource in question (assuming other barriers are absent). With exclusive and secure property rights, resource depletion is internal to the owners/users, while under open access it is external to the users. The consequence of this internalization is that the owner will not engage in resource extraction unless the

price of the resource commodity covers not only the extraction cost but also the depletion or user cost, which is the foregone future benefit as a result of present use.

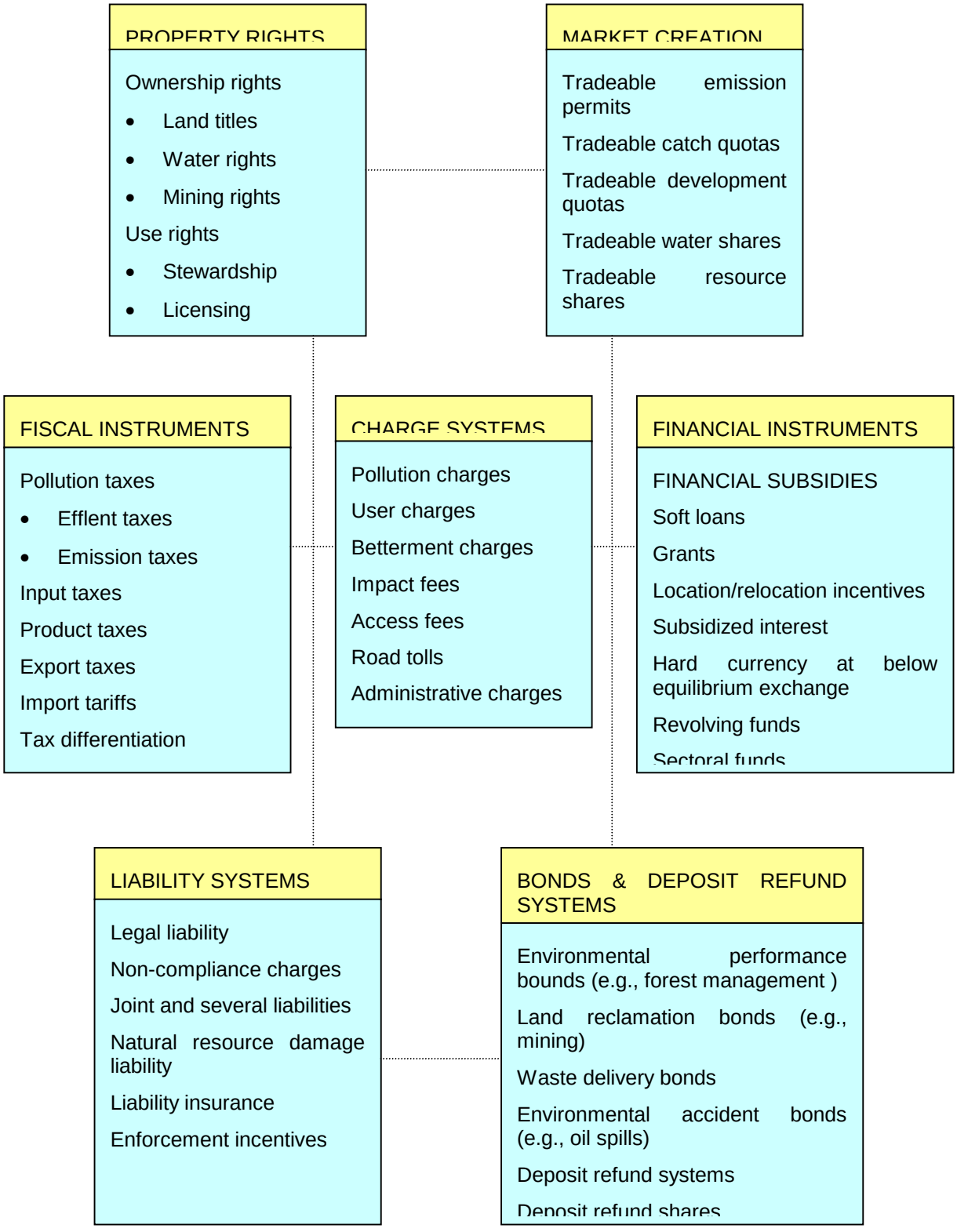
With secure property rights, the price of resource commodities such as minerals, oil, and timber would reflect the resource depletion cost and provide the right signals for efficient use and conservation in line with changing relative resource scarcities. This result is based on three assumptions: (a) that the resource markets that would emerge following the assignment of secure property rights would be competitive; (b) that there is no divergence between the private and the social rate of discount; and (c) that there are no significant externalities (such as environmental impacts) from resource extraction that have not been internalized through the established property rights. If these conditions are not met, secure property rights alone would not suffice to create the right incentives for socially optimal resource allocation: uncompetitive markets will lead to a distorted time path of resource use; higher private discount rates would lead to faster resource depletion than is socially optimal;[1] and unaccounted, negative environmental externalities would have a similar effect. Hence, additional instruments would be necessary to promote competition or regulate monopolies, to induce a longer time horizon and to internalize off-site effects. The policy maker has again a large tool kit of economic and regulatory instruments (taxes, charges, subsidies) to choose from to complement the assignment of property rights, as we will see below. Nevertheless, assignment of secure, exclusive and transferable property rights goes a long way in correcting the incentive structure and altering the behavior of resource users to one that more closely conforms to socially responsible behavior.

Assignment of property rights as an instrument for the internalization of external cost has several advantages: (a) it goes to the root of the problem, the absence or malfunctioning of markets due to undefined property rights; (b) it relies on the government to do what it does best, (i.e., to create the institutional infrastructure and legal framework for the efficient functioning of markets—the government allocates property rights and the markets allocate resources); (c) since the government does this only once, leaving future changes of property rights to the market, it has relatively low administrative costs and it minimizes distortionary interventions in the price system; (d) property rights can be easily attenuated (restricted in certain ways) to internalize other external costs or to pursue other social objectives, through liens, easements, and other restrictions of use and disposal; (e) unlike taxes and charges, property rights adjust automatically to changing circumstances (i.e., once established they meet the automaticity criterion from then on); (f) regardless of how property rights are distributed, efficiency is ensured as long as the property rights have certain properties such as clarity, exclusivity, transferability and enforceability, and no other market failures are present.

The property rights approach to the internalization of external cost has a number of limitations which, though important, do not outweigh the advantages in most circumstances, and could be remedied with additional instruments. One limitation is that the assignment of property rights is a politically contentious issue subject to rent seeking and corruption and can be used as an instrument to achieve political objectives (e.g., reward political supporters). A second limitation is in how property rights are assigned (distributed), this has momentous distributional implications: if granted free of charge, property right holders are given ownership to the entire present value of the infinite stream of rents flowing from the resource; if the rights are sold or auctioned, the issuing authority acquires the present value of rents which it can then expend or redistribute according to its own social, environmental, economic, or other objectives. The once-and-for-all distributional impact or property right assignment has a double-edged implication for social policy. On the one hand, it can be used as a means of improving wealth distribution; on the other hand, it creates strong pressures from politically powerful groups and organized interests who stake a claim to rights over natural resources in the public domain. While the assignment of secure property rights to open access resources is certain to improve efficiency, management and conservation, it may also deprive the poor of access to common resources important for survival, unless they are the recipients of the property rights.

[1] Assuming the extractive industry is not capital intensive.

Figure 2. Economic Instruments for Environmental Protection and Natural Resource Management



Property rights need not be private—they can be communal or public (state)—but they need to be well-defined, secure, and transferable if they are to effectively internalize depletion costs. Where traditional, customary or communal rights exist, the best policy might be the recognition and strengthening of these rights rather than their supplantation with private property rights, especially if the latter is alien to the local culture.

Property rights are particularly applicable to land and soils (**land rights**), water resources (**water rights**), minerals (**mining rights**), and other natural resources which can be parceled out and enclosed or their boundaries easily demarcated and defended, as the ability to exclude non-owners is critical to the effectiveness of property rights as an economic instrument that induces rational resource use. Property rights are less applicable to situations where the resource is mobile or fugacious, i.e., it moves across boundaries (e.g., marine fisheries), or where significant externalities infringe on the content of the property rights, as when downstream land, water or a fishery resource are the receptors of upstream externalities (e.g., damage from floods or water pollution resulting from upstream deforestation or runoff of agrochemicals). In both these cases—a fugacious resource or significant externalities—the security and exclusivity of the property right is compromised and the right might no longer act as an incentive for efficient use and management; at the limit, the behavior of the "owner" resembles that of an exploiter of open-access resources who maximizes short-term capture and minimizes long-term investment. This behavior is also exhibited by farmers with only use rights or insecure land titles: they tend to "mine" rather than farm the land.

Finally, property rights (at least in their conventional form) are not a suitable instrument for environmental management where the resource itself or its use generates significant externalities, for example, a forest in an upstream watershed. In this case, property rights to the forest within the watershed would fail to internalize the environmental benefits of forest conservation (and environmental costs of forest harvest) to downstream activities. The result would be too little forest conservation and too much forest harvest from the society's point of view. If the externality was private, involving one or very few easily identified parties, the assignment of secure property rights to both upstream and downstream activities would have been sufficient to produce an efficient allocation, through either (a) bargaining between the parties involved or (b) unitization, that is, one party would buy out the other and unify the upstream and downstream activity under a single management (i.e., internalize the externality).

In the case of a public (widespread) externality with many sources and receptors, the bargaining between the parties is constrained by high transaction costs (information, negotiation, policing, etc.). Unitization, which can be effected either through assignment of property rights to the entire river basin or to a single owner, could result in monopoly control (another market failure) even if the distributional considerations could be addressed. A consequence of the above limitations of property rights is their unsuitability for management of environmental resources such as air, water, atmosphere and the global climate. However, as we will see below, it is still possible to use the advantages of property rights without their limitations in the protection of the environment and management of fugacious resources through innovative market creation (e.g., tradeable emission permits, tradeable catch quotas, etc.).

As shown in Figure 2, property rights are of three main types: (a) ownership rights, such as land titles and water rights; (b) use rights, such as licenses, concession bidding, usufruct certificates, and access rights (e.g., to roads, parks, etc.); and (c) development rights as distinct from both ownership rights and use rights. Unattenuated, indefinite ownership is the purest form of property right while short-term use rights lie at the other extreme. For scarce resources with no significant externalities, unattenuated, private ownership rights are likely to result in the most efficient resource use and management (including long-term investment and conservation), provided private property is consistent with the social norms and traditions of the society concerned; otherwise, the private property owners would not feel fully secure or high enforcement costs would partially or fully offset the social gains from improved resource management. Divergence between the private and social discount rates also creates a wedge between private and social objectives but it does not, by itself, "invalidate" private ownership. As an economic instrument of efficient revenue allocation, it can be bridged either by eliminating the source of the divergence (economic and political uncertainty, high-interest rate policies, etc.) or by introducing supplementary economic or regulatory instruments (e.g., maximum allowable cut, tax on the rate of resource extraction, or subsidies for soil conservation).

Attenuation of property rights through regulation of use (e.g., building-plot ratios) or restriction of certain types of development (zoning) are often used to internalize externalities or public good

aspects which are significant but not significant enough to "invalidate" private property. Economic instruments such as differential land use taxes, development charges, impact fees, etc., can be used for the same purpose.

One form of attenuation of property rights is the complete separation of development rights from ownership rights, through the instrument of **transferable development rights** (TDRs). Without challenging property ownership (and entitlement to the benefits from ownership), all or certain types of development are prohibited on site in the name of the public interest, but property owners are allowed to transfer to other sites or sell to others their development rights and thereby recover their full market value. Demand for such rights is ensured by allowing extra development (beyond building or zoning regulations) to the holders of transferred development rights. Both the ratio of transferred development rights to additional development entitlement and the percentage by which existing regulations can be exceeded in each zone are specified by law. The instrument of TDRs has been used extensively in the conservation of historical buildings, archeological sites, cultural heritage, wetlands, and coastal areas, and is today under consideration by a number of countries as an instrument for the conservation of greenbelts, forests, and biodiversity.

When externalities or public good aspects are pervasive as in the case of critical watersheds, forests with significant ecological functions, fisheries, wildlife, and biodiversity, the necessary restrictions and regulations of private use could be so many and their enforcement so costly that collective forms of ownership are a more efficient means of internalizing environmental costs. If externalities are local (e.g., local watershed, village forest, or local fishery), **communal property rights** combined with private use rights (regulated by the community) could internalize external costs with minimal management efficiency loss, especially when the community has a cohesive social organization and a tradition of collective resource management. It is important to stress here that the management responsibility for the communal resource (regulation of use, conservation, protection, and investment in productivity enforcement and sustainability) lies with the collective owner, the community, not the individual users. The community may exercise the management responsibility either directly through collective community institutions or internalize it to individual users through obligations, regulations, norms, taboos, and various social sanctions.

User rights by themselves do not ensure efficient use and sustainability, because a user that conserves or invests in the resource assumes all the costs yet can capture only a small part of the benefits; the rest accrue to other users who have an incentive to free ride. Even in resources with minimal externalities, (e.g., cropland), use rights that are limited in duration and nontransferable (e.g., usufruct or stewardship certificates), conservation, and investment are discouraged by (a) short-time horizons or uncertainty of tenure and (b) inability to recoup the costs and liquidate any equity value accumulated through investment in the resource such as land improvement, soil conservation, and forest regeneration. Classic examples are logging firms with short-term forest concessions or shifting cultivators, and farmers with short-term tenure. The problem can be partially addressed through longer duration, renewability, and transferability of concession and use rights. At the limit, indefinite, freely transferable, comprehensive and exclusive use rights are equivalent to full ownership rights.

Where externalities or public good aspects dominate (e.g., major national watersheds, offshore fisheries, biodiversity, and unique environmental assets), the most efficient means of internalization is likely to be state ownership with regulated individual use rights through concessions and licensing. In this case the management responsibility lies with the state and could be exercised either directly through state agencies or indirectly through regulations and incentives. In the case of global public goods such as forests and biodiversity, where national sovereignty precludes global community property rights, internalization is effected through global conventions and international transfer mechanisms, internationally tradeable emission permits, or transferable development rights (see Chapter 6 below).

Market Creation

As we have seen, property rights in their conventional form are not an appropriate instrument for the protection of the environment, unlike their use in natural resource management. In the case of most natural resources, a great deal of the benefits and costs of resource use and conservation occur on site and therefore can be made internal to the user through secure ownership of the site. Property rights effectively internalize depletion cost (scarcity value) and on-site environmental cost. Any external cost (off-site effects) or public-good aspects are internalized through supplementary instruments such as regulations and incentives. In the case of environmental pollution, individual

property rights to the environmental media of air, water, and atmosphere are neither feasible (exclusion is not technically possible) nor desirable (zero opportunity cost to allowing more people to enjoy clean air). Indeed environmental quality is a public good which is grossly undersupplied by free markets because it is not possible for private providers to recoup the cost of supply.

One solution is for the state to provide the desired level of environmental quality (like other public goods) and pay for it through general taxation. This can be effected through a combination of pollution control regulations, incentives, and public investment in pollution abatement. An alternative (often a more cost-effective one, as we will see below) is to try and mimic the market, in fact, to create a market in environmental quality. This approach treats the environment as a scarce, yet unmarketed and unpriced resource which is overused because it is free. A solution, thus, might be to create a market in which the right to use the environment as a waste sink (a sort of use right) is assigned, priced, and traded. Assignment (i.e., definition and allocation of the right to use the environment) would ensure a total aggregate use to the desired level of environmental quality, and specify the content of individual rights (shares). Pricing, the consequence of scarcity (resulting from the issuance of fewer environmental-use rights than demanded), would ensure a more rational use of the environment, because the more it is used the more it costs. Trading of pollution rights (or permits) would ensure that the assimilative capacity of the environment, a scarce resource, is put to its best possible use. Over time, economic growth and the need for expansion of economic activity would induce industries to become increasingly more efficient in the use of the environment, to further reduce waste per unit of output, and to develop new polluting technologies and products as well as more efficient pollution abatement methods, to make room for expansion with the limited number of pollution permits.

Tradeable emission permits are a form of market creation. An aggregate level of allowable emissions is set for each airshed or watershed and allocated among polluters either according to the level of output or current level of emissions. Since the aggregate emissions quota is set at or below the current level of emissions, an artificial level of scarcity is created and permits acquire positive value (market price). Industrial producers with a deficit of permits or with expansion plans must secure emission permits by reducing emissions from existing plants. Alternatively, they may purchase permits from other polluters who are either able to reduce emissions at a lower cost than the industrial producers can or who find it more profitable to sell their permits than use them themselves. Thereby, the desired reduction of emissions (and hence the desired level of ambient environmental quality) is attained at the minimum possible cost to society and a strong incentive is provided for continued efforts to improve efficiency and to develop cleaner technologies. Even if the aggregate quota is set at the current level of emissions, the expansion of economic activity would create a scarcity of permits with all the desired incentives described above. Furthermore, government and non-government environmental organizations have the option to purchase and retire pollution permits in order to speed up an improvement in environmental quality.

Whether the emission permits are issued free of charge, sold at a fixed price or auctioned to the highest bidder makes no difference from the point of view of efficiency. As long as they are fixed in number and freely tradeable, the level of emissions reduction will be attained at the lowest possible cost to society. Distributionally, it matters a lot. Awarding pollution permits to polluters free of charge amounts to assigning property rights to them over the assimilative capacity of the environment, or at least a use right, up to the specified level described in the permit. Thus, the permit entitles the polluter to the present value of the stream of profits arising from free disposal of the allowable amount of emissions into the environment. If the permits are instead sold or auctioned, the state is the recipient of the revenue, which can then be passed on to the citizens either in the form of an increased supply of public goods or lower taxes.

Alternatively, emission permits could be allocated to the general public (say, one person one permit) with the total number of permits fixed at the socially acceptable level of emissions. Polluters would then have to buy their permits from the general public which has, under this allocation, the entitlement to the present value of benefits from the use of the assimilative capacity of the environment. In other words, the general public has the right to an unpolluted environment and should be compensated by the polluters for any reduction in environmental quality. (This, unlike the allocations discussed earlier, is consistent with the polluter pays principle). Different combinations are also possible, e.g., 50% to polluters and 50% to the general public; or 30% to current polluters, 20% to future polluters, 20% to the public 20% to the government (or the environmental protection agency) and 10% to environmental NGOs.

Whatever the allocation, efficiency and environmental quality is not compromised, only the distributional implications are different. Therefore, those who criticize pollution permits as a right to pollute are correct only in the case where the polluters are given the permit for free. If the polluter has paid a market price for the permit, the criticism could only be that the "price" of the permit is "too low," or the supply of permits is "too large," which is the equivalent to saying a higher level environmental quality is desired.

Establishing a system of emission permits has relatively high management costs: (a) it requires proper definition of airshed (trading permits across airsheds would create hot spots), which in turn requires knowledge of the sources and of the movement of pollutants under the local atmospheric conditions; (b) monitoring of ambient air quality in the airshed (or water quality in the watershed) and the relationship between emissions and ambient quality; (c) capacity to monitor or randomly inspect individual emission sources to ensure that the emissions limit specified in the permit is observed; and (d) a system of approving and recording credits, offsets, and trades among permit holders. Depending on the type of pollutant and the content of the permit, management requirements could be significantly reduced. For example, in the case of a global pollutant such as CO_2, there is no need to define the airshed since it makes no difference where in the world CO_2 is emitted or controlled. In the case of local pollutants, systems of self-reporting, auditing, and random inspection with sanctions for violations may suffice to replace a formal system of approving and recording credits, offsets, and trades. Incentives for self-enforcement and group policing can be introduced to minimize monitoring and enforcement costs.

Tradeable emission permits are nothing but tradeable emission quotas, a concept that has wide applicability beyond air and water pollution and greenhouse gases. Consider the example of a mobile (or fugacious) resource such as an offshore fishery suffering from overfishing. Property rights cannot be assigned but a total allowable catch or aggregate catch quota can be set (at say the maximum sustainable economic yield) and allocated to existing fishermen in some equitable way (e.g., according to average historical catches). Potential entrants can be accommodated by reserving quotas for them or through the purchase of quotas from retiring fishermen. If trading is allowed, the individual tradeable quotas would gravitate towards the most efficient fishermen, ensuring that the allowable total catch is caught at the minimum possible cost. Thus overfishing is eliminated, the fishing resource is protected, economic efficiency is achieved (i.e., fishery rents are maximized), and fishermen who choose to leave the fishery, making all this possible, are fully compensated. New Zealand has successfully used this system to manage its marine fishery (see Chapter 4).

Space limitations do not allow discussion of all the available instruments in the category of market creation. Two more examples of instruments should suffice. A number of countries with substantial tourist industries are facing a serious problem of expansion and haphazard development of their most popular resorts. In fact, the more attractive a resort is the more likely it is to be degraded by over-development. Experience shows that zoning and building regulations have been ineffective in many parts of the world to regulate development and to maintain the quality of the tourist product (especially in coastal areas). Examples range from Southern Europe (e.g., Spain) to Southeast Asia (e.g., Thailand) to the Caribbean (e.g. Barbados). Some countries (e.g., Cyprus) were forced to introduce moratoriums on all hotel and other tourism-related development for several years. The moratoriums were later swept by the avalanche of accumulated applications, pressures for hotel development, and a rush to build mostly poor quality establishments from fear that the moratorium might be re-introduced. This is an example of a command and control intervention that has clearly backfired, causing the rate of construction to accelerate and its quality to decline, further downgrading the island's tourist product.

Policy makers are searching for instruments that will help them control and guide the pace of new development in tourist centers in desirable areas and directions and to upgrade existing establishments, thereby improving environmental conditions and the quality of their tourist product. **Tradeable development quotas** are such an instrument. The relevant authorities can set a maximum allowable development (or construction) quota, measured in, say, cubic meters of buildable space (or number of rooms) for each year, in each area or zone, consistent with their objectives to limit development and improve quality. The aggregate quota in each area can then be allocated according to some equitable (widely accepted) formula. Possible alternatives include auctioning to the highest bidder with the revenue going towards the upgrading of public places in the town (e.g., developing parks, improving roads, cleaning beaches, and reducing air and noise pollution). An alternative allocation is by proportion of land-ownership in the tourist zone. Under this arrangement each recipient of a quota would have the choice of using it in his/her own land, selling it to others or simply

banking it for future sale or use. The quotas would thus gravitate to those with the most profitable development plans and projects; since the quotas would have a high and possibly rising scarcity value, they would be used only for high-quality tourist development with more open spaces, green areas, and environmentally sensitive landscaping that would allow for charging higher prices. Additional development quotas could be acquired by a developer through retirement of equal (or larger) (e.g., 1.5) existing built-up space in the same zone. This would act as a strong incentive for upgrading existing establishments, since no-one else would be willing to incur the cost of demolition and new construction unless he/she planned to develop a higher quality, more profitable establishment. Moreover, owners of low-quality units can always sell their grandfathered development rights in the market for development quotas. The upgrading of existing units can also be accelerated by setting a less-than-one-to-one ratio of grandfathered development rights to development quotas or by introducing a graduated charge on built-up space (old and new), which would also vary by quality of establishment (two to three classes of quality). Development quotas and development rights can be made tradeable across zones, but the terms of trade must be specified by the issuing authorities to prevent “hot spots” of overdevelopment.

Another example of market creation is **tradeable water shares.** This is similar to water rights but distinct in that the resource is indivisible in its physical dimension but divisible in its use (analogous to the environment). Consider surface irrigation systems in developing countries. Farmers receive irrigation water free of charge. The result is overuse by those with easy access, with consequent waterlogging and salinization of soils and shortage, and water stress for those further afield or downstream. The consequence is that the value of the marginal product of water in much of the irrigated agriculture is near zero or even negative, while other users (cities, industry, farmers with inadequate and unreliable supplies) are willing to pay a high price for additional water quantity (the value of this marginal product is several times higher than that of farmers with easy access to irrigation systems). Calls for irrigation water pricing have been rejected by both farmers and governments as regressive and unfair since farmers are often among the lowest income groups.

Tradeable water shares can address all the equity concerns of policy makers and at the same time improve the efficiency of water use by directing it to its higher value use. In fact, this instrument can improve income distribution, water resource conservation, and environmental protection (as new dams become unnecessary) at the same time as it improves economic efficiency and maximizes the aggregate benefits from this scarce resource (all necessary conditions for sustainable development). Tradeable water shares work as follows. The irrigation authority issues to farmers and other water users in the command area of a water system percentage shares to the water stored in the system during each season. Each shareholder knows his/her entitlement by multiplying the total amount of water in the system announced by the water authority each season by his/her share. For example, if the total quantity of water announced is 100 million cubic meters, if there are 20,000 households in the command area, and if an egalitarian allocation formula is chosen, the individual farmer's share would be .0005 which equals 5,000 cu. m. (= .0005 × 100,000,000) for the season.

The farmer or rather, the water holder, is free to dispose his/her water share as he/she pleases: use it in his/her own field, sell it to another farmer, bank it for future use or sell it back to the water authority at the prevailing market price for use elsewhere (e.g., to supply urban users). A number of outcomes are certain: (1) the water share holders would use their water share as they judge to be best for themselves, and they would be significantly better off as a result; (2) water scarcity in previously deficit areas would fall and the effective price that users pay would be reduced; (3) water would be flowing to the higher value use much in the same way as it flows downhill by gravity; (4) water would be used efficiently by both rural and urban users and conserved as a valuable commodity; and (5) supply expansion would become unnecessary or postponed for several years, saving the environment the impacts of new dam construction.

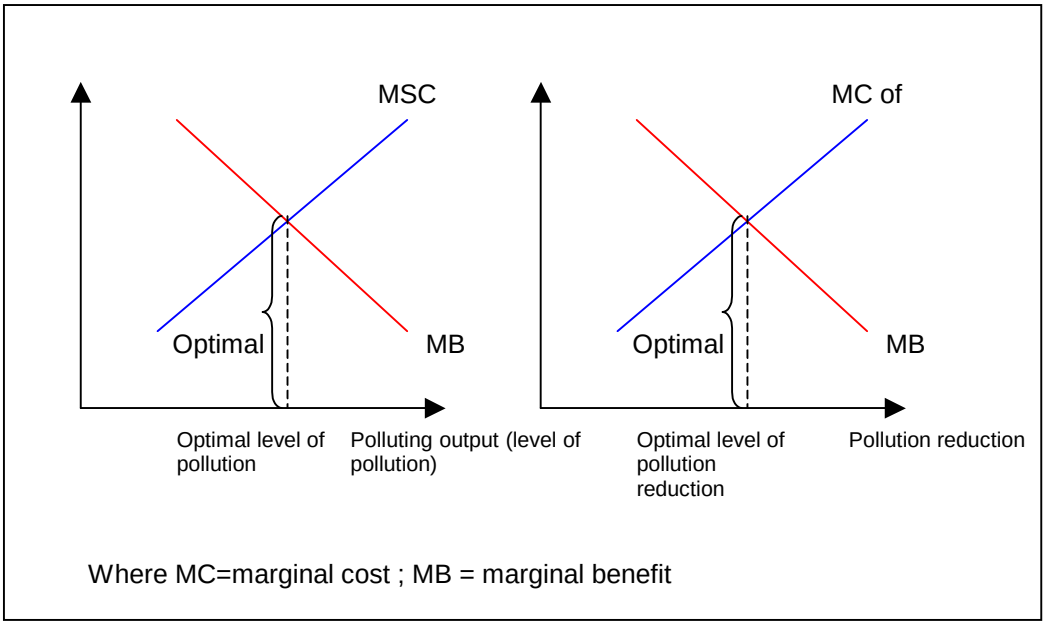
The institution of tradeable water shares does presume the ability to meter water and monitor use, but these requirements are not beyond the capability of most water authorities and irrigation departments; where they are, there are alternatives such as the allocation of shares to water user associations who in turn allocate them to their members using their own (informal) distribution and monitoring mechanisms. Possible objections might be raised by those who currently use large quantities of water, either because they are large landholders with free water access due to their proximity to the system, or because they cultivate water-intensive crops. This issue again can be addressed by selecting a share allocation formula that takes these concerns into account through partial grandfathering of existing users. In principle, there is no inherent difficulty in allocating shares to people outside the command area of a system, and it is especially desirable to do so for people in the

catchment (or watershed) area of the system. Fiscal instruments such as taxes, royalties, or charges can be imposed on water share holders to skim off part of the rents (or of the annual water share appreciation) to fund the maintenance of the system and the protection of the watershed.

Fiscal Instruments

Fiscal instruments such as taxes and subsidies could be used to bridge the gap between private and social costs/benefits. For example, the prices of polluting products such as gasoline or pesticides do not incorporate the social costs of damage to peoples' health and other activities which arise from their use because these costs are external to the decision maker (producer or consumer). Hence polluting inputs and final products are generally underpriced, both absolutely (in terms of social costs) and in relation to non-polluting or less polluting products. This results in overproduction and overconsumption which in turn result in environmental damage at a higher than socially optimal level.

Environmental taxes can then be used to effect full-cost pricing (i.e. to bridge the gap between private and social costs). To do this, the tax should be set exactly equal to the marginal environmental damage corresponding to the socially optimal level of pollution. This tax, known as a Peguvian tax, is the embodiment of full-cost pricing, adjusting the price of a good precisely by the amount of the reduction in social welfare caused by the externality associated with the good. The result is not a zero level of pollution externality but an optimal level: where the marginal benefit from the reduction of pollution equals its marginal cost; or alternatively the marginal damage (social costs) equals the marginal benefit from the production of the good, as shown in the figures below.



Environmental taxes can be levied on (a) the pollutant itself (i.e., on effluents, emissions, or solid waste), or (b) on final products associated with environmental externalities. Taxes on pollutants, known also as pollution charges, are applied directly to the offending substances thereby providing the maximum incentive and flexibility for the polluter to reduce pollution; therefore pollution charges are more efficient than indirect taxes on inputs or final products. The latter does not provide an incentive to limit the pollutant itself, only to use less of the input or produce (consume) less of the final product. For example, taxes on products or inputs do not provide incentives for the development and installation of pollution abatement technologies. Only when the pollution-product coefficient is fixed are pollution charges and polluting product taxes equivalent. Depending on the elasticity of supply and demand, part or all of the pollution charge would be reflected in the price of the final product—a strong incentive for the polluter to switch to products that are less harmful to the environment.

Emission and effluent taxes can be structured in such a way as to provide a progressive incentive for pollution control. For example, in Germany, polluters who more than meet the set effluent standards are charged a lower rate while those who violate the standards pay a higher rate than the charge set for those who meet the standard. Emission taxes face a number of difficulties: (a) to set

the correct tax we need estimates of the marginal benefit and marginal cost curves to determine the optimal pollution level; (b) a low tax does not provide much of an incentive for environmentally sound behavior, yet higher tax rates require complex tax structures and administrative mechanisms; and (c) taxes based on actual discharges involve significantly higher administration and enforcement costs than taxes on products.

Taxes on inputs and final products whose production or consumption are associated with pollution externalities, though indirect and hence less efficient, have the advantage of relying on the administrative procedure of the existing tax systems. No monitoring of the sources and levels of emissions or effluents is needed and product taxes can be easily collected from producers at the time of exchange (sale, export, import). Examples include taxes on fuels, on industrial chemicals, and on pesticides. The tax induces reduction in the use of these products and proportional reduction in the production of pollutants but provides no incentive for pollution abatement; its ability to act as an incentive for pollution reduction depends on its level being high enough and the demand for the product elastic enough to discourage the consumption and thus production of the product. Environmental taxes on final products are particularly suited to the control of consumption-related pollution, because consumers are made aware, through higher prices, of the environmental consequences of their choices.

An environmental tax on final products can be adjusted to ensure international competitiveness; exports can be exempted, since the products are not domestically consumed and inputs can be made subject to an equal environmental duty.

In the case of raw materials and intermediate products, a uniform environmental tax may result in distortions and perverse incentives if some inputs or uses result in greater environmental damage than others. To remedy this problem a **differential tax structure** is often introduced—materials with higher levels of externality are charged higher tax rates, while environmentally friendly products have their regular tax rate reduced. The purpose is to induce a switching from polluting products to environmentally-friendly substitutes. If no such substitutes exist, differential taxation becomes a distortion. Since tax differentiation has by definition an incentive purpose, the differential tax is often calculated to be revenue neutral. An example is provided by the differential taxation of leaded and unleaded gasoline practiced in Thailand to induce switching to a cleaner fuel.

Fiscal instruments include not only taxes but also **subsidies**. Instead of taxing the polluters to reduce pollution to the optimal level, polluters can be subsidized to do exactly that. The optimal environmental subsidy is also equal to the marginal environmental damage at the level of the optimal tax. The outcome in terms of environmental improvement and static economic efficiency (resources expended for the improvement are minimized) is exactly the same except for differences in the transaction cost between collecting taxes and paying subsidies. There is, however, one dynamic difference which favors taxes. In the long-run subsidies tend to induce new entrants into the industry (or the expansion of existing producers) which results in both an increase in pollution and an increase in the cost of the subsidy. Distributionally, the burden of environmental taxes falls on the producer and consumer of the polluting products while that of the subsidies falls on the taxpayers. In this connection, subsidies violate the widely accepted polluter pays principle of distributing pollution control costs.

Governments wanting to abide by the above principle and, perhaps more importantly, facing growing budget deficits, do not usually favor environmental subsidies; yet most governments are rather generous with **investment tax incentives**. The most common such instruments are investment tax credits and accelerated depreciation for pollution control equipment and waste treatment facilities. While their impact on the budget is no different than that of subsidies, and while they equally violate the polluter pays principle, investment tax incentives are popular with governments because, (a) their costs are hidden from public scrutiny and hence are an expedient way to provide hidden subsidies, and (b) they give an appearance of promoting environmental protection without reducing competitiveness. Of course, the latter is not assured since the installment of the mandated (and subsidized) pollution abatement facilities does not guarantee their efficient functioning. Indeed, many mandated water treatment facilities are often found to be unserviceable to avoid operating and maintenance costs. Since there is no incentive to actually reduce pollution (only to install the equipment), the investment incentive subsidizes the overall investment and thereby induces an increase rather than a decrease in the level of pollution. Investment tax incentives are generally a source of distortion with hidden but large costs that should be avoided as much as direct subsidies. Tax incentives for environmental investments, in the form of both tax credits and accelerated depreciation are practiced in Canada, France, Korea and Taiwan, among others, while both Japan

and Germany provide for depreciation and the Netherlands provides tax credits for environmental protection investments.

An interesting tax credit incentive which operates in Costa Rica is known as the **transferable reforestation tax credit**. Land owners who chose to keep their land under forestry (or plant native species) receive a tax credit (i.e., they can deduct part of the costs from their taxes). This scheme benefits in particular, big, wealthy land holders who pay a significant amount of tax. To enable small land holders to share in the benefit of the scheme, the government introduced a transferable tax credit system: small-holders who keep their land under forestry earn tax credit which they can sell to wealthy taxpayers with high taxes to offset. The annual nature of both the credit and the investment (maintenance of land under forest) makes this tax credit scheme more effective than those discussed earlier. Yet a differential land use tax could have achieved the same result more directly.

Such a **differential land use tax** has been operating in Germany for several years. Land uses are classified in a number of categories ranging from most environmentally beneficial (e.g., natural forest) to most environmentally destructive (e.g., industrial site). A charge is imposed on the land owner when he changes land use from a higher to a lower class. The more steps involved in environmental downgrading the greater the charge (charge X number of steps). For example, the charge for downgrading from forestry to an industrial site is far greater than from agricultural to residential use. The effect of this differential land use tax is to internalize the environmental costs of forest conversion and land use change. A similar system has been proposed for Thailand that involves a system of land use taxes and subsidies depending on the corresponding externalities (see Panayotou 1991).

A number of countries use tax credits and subsidies as **industrial relocation incentives** to induce polluting industries to move out of urban centers where the impact of pollution is high (due to exposure of large population, limited ventilation, overburdened assimilative capacity, etc.) to less populated areas or industrial zones. Such credits and subsidies are justified by the high cost of relocation, the freeing of high-value land for more productive uses (e.g., residential or commercial), and economies of scale in pollution control which come from consolidating similar industries within industrial estates. Turkey, for example, offers a 40% tax deduction on investment during the two years of industrial estate construction. (Small and medium size tanneries receive a 7% rebate on investment.) As a temporary incentive for relocation, the tax credit has some merits but if maintained for a long time it will become a subsidy for polluting industries, increasing pollution, and draining the government budget.

Environmental taxes, if properly structured, can become a major thrust of **fiscal policy reforms.** Conventional taxation throughout the world taxes work, income, savings, and value added and leaves untaxed (even subsidizes) leisure and consumption, resource depletion, and pollution. The implied reduced incentives for work, savings, investment, and conservation and the increased incentives for leisure, consumption, resource depletion, and environmental degradation result in less growth and more environmental degradation than would have been the case had incentives been the reverse.

A reform of the fiscal system that would reduce conventional taxes and replace them with environmental taxes, so as to leave the total tax burden unchanged, would bring the economy closer to sustainable development by stimulating economic growth and resource conservation and discouraging resource depletion and environmental pollution. This is clear to see since the existing fiscal system of taxing social benefits introduces market distortion, while a reformed system that taxes social costs would remove market distortions and mitigate market failures. A fiscal reform, which is by design revenue neutral, could not generate additional revenue but it would save government expenditures on environmental regulation and pollution abatement and, in the long run, increase the tax base and hence tax revenues without increasing the tax burden.

While an overnight shift from “taxes on value” to “taxes on vice” is unlikely and potentially disruptive, a gradual shift towards environmental taxes would be a move in the right direction. For example, income taxes could be reduced and the lost tax revenues replaced by taxes on gasoline, chemicals, and other polluting products. Of course, it would be more efficient to tax pollutants (SO_2, CO_2) directly rather than polluting products (fossil fuels), but tax setting and collecting would be more complex and costly, especially in developing countries with limited administrative and technical capability. Differential taxation of products and services (differential VAT), according to its environmental externalities has been used with some success in Western Europe and it holds even greater promise

in developing countries undergoing their formative years of industrial development.[2] True, product taxes tend to be regressive, but so are most conventional taxes; care must be taken in the design of such taxes so that the overall tax burden is progressive rather than regressive.

Charge Systems

Environment charges are rarely distinguished from environmental taxes and are often used interchangeably, creating an unnecessary source of confusion and often a source of friction between Ministries of Finance and Environmental Agencies. In this study we distinguish between charge systems and fiscal instruments. Charges are defined as payments for use of resources, infrastructure, and services and are akin to market prices for private goods. One way of thinking of charges is as "prices" for public goods or publicly provided private goods. They differ from market prices for private goods because they are not market determined but are administratively set by a government agency, a public utility, or other types of regulated natural monopoly. This contrasts them with taxes which are not payments for "services" but a means for raising fiscal revenue. Peguvian taxes, however, may be thought of as a charge for the use of the environment's assimilative capacity (a natural resource or public good) and hence, analogous to a user charge.

A second difference is that taxes are connected to the budget, forming part of the general government revenues while charges are extra-budgetary, aiming to recover cost for a specific public investment or more appropriately, to finance the long-term marginal cost of supply. More importantly, charges are used as instruments of demand management and when set optimally (equal to the long-term marginal supply cost), they may or may not recover supply cost. When the long-term marginal supply cost is falling, "optimal" user charges result in a deficit; when it is rising, they result in a surplus. The deficit is usually met by a subsidy from the general budget, while the surplus either goes to the budget or more often is prevented through regulation of the tariffs charged by a public utility.

This connection with the general budget and the propensity to supply utilities (e.g., water, electricity), public services, and use of infrastructure at zero or nominal cost, charges are perceived more as taxes than as prices. Yet, because there is still a correspondence between use and payment, user charges are still seen as a means of partial cost recovery rather than as a source of general revenue. If anything, finance ministries might welcome a severance of the link between deficit generating utilities and the general budget. However, a problem does arise in the case of pollution charges, which (a) are not seen as a means of cost recovery or payment for service or resource use and (b) can potentially raise large amounts of revenue. Environmental ministries prefer to view pollution charges as user fees and want the revenues earmarked for environmental investments to abate pollution and to rehabilitate degraded environments.

Finance ministries prefer to view pollution charges as taxes and hence as a source of general revenue to be allocated between alternative uses in order to maximize the social rate of return without regard to the origin of the revenues. Earmarking is simply viewed as a distortion.

While there is a serious issue here, which is addressed in the companion study on environmental financing (Panayotou, forthcoming), the exclusive emphasis on the financing effect of charges in general (as in cost recovery) and of pollution charges in particular, is misplaced. The primary objective of charges ought to be the change in the incentive structure facing the users of scarce resources so as to induce a realignment of their behavior with social interests. In this spirit, user charges are instruments for reducing wasteful use, managing demand, and inducing conservation and secondarily, are instruments for recovering cost or financing supply expansion. Similarly, pollution charges are instruments for internalizing external costs and encouraging pollution control and, are also a means for raising revenues to finance environmental investments. It is possible to design a system of charges that is revenue neutral (i.e., it raises no revenues), yet accomplishes the desired level of pollution reduction.

We may divide charge systems into three groups. The first group may be called pollution charges, this includes emission charges, effluent charges, solid waste charges, noise pollution charges, and product charges. When set at optimal levels (equal to the marginal damage cost), pollution charges are identical to Peguvian taxes.

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[2] A major limitation of a differential VAT in which tax rates vary with the products' pollution coefficients (or environmental damages) is its complexity and cost of administration while a simpler tax rate structure might be too blunt an instrument for internalizing environmental costs.

The second group of charges may be called direct or “active” user charges which include utility charges (e.g.. for water, electricity, etc.), road tolls, and access fees to parks, beaches, etc. These charges are analogous but not identical to prices for private goods. Road tolls, for example, may be thought of as congestion prices not as prices for gaining access to roads. If there is no congestion, restricting access to roads through road pricing reduces social welfare because there is an unused opportunity to make someone better off without making anyone worse off (known as “Pareto improvement”).

The third group of charges may be called indirect or “passive” user charges and they include betterment charges and impact fees. Betterment charges are usually imposed on private property which benefits from public investments. For example, private property values may increase manifold as a result of new roads, parks, environmental clean ups, etc. While property taxes capture some of the windfall appreciation, betterment charges may also be imposed to collect revenues for financing the relevant public investment or for partial cost recovery. This is an application of the beneficiary pays principle and could be a major source of financing, but its incentive effect is rather limited and indirect: betterment charges, if sufficiently high, may reduce the incentive for private land owners to lobby government officials to influence the location, type, and level of public infrastructure and services in order to benefit their property. Impact fees are charges that aim to internalize the external cost of private investments (construction, tourism, or industrial development) on the landscape or the ambient environment. For example, a charge may be imposed per cubic meter of built up place. The incentive effect here is stronger than with betterment charges, especially as it applies to new construction. As such impact fees may be classified as “visual pollution charges” and included in the first group, impact fees generally refer to a much larger set of environmental impact, and may, in a sense, be thought of as the reverse of betterment charges.

Financial Instruments

Financial instruments have many similarities with subsidy and tax incentive systems and share many of their limitations as well. Financial instruments are distinguished from fiscal instruments because they are often extra-budgetary and financed from foreign aid, external borrowing, debt for nature swaps, and the like. Since funds are fungible and loans must be serviced and repaid somehow, the implications of financial subsidies are not very different from those more closely connected with the government budget. Often the motivation behind the creation of special funds for environmental protection or resource conservation is to avoid the scrutiny of the budgetary process. Yet, the propensity of many finance ministries to underspend on resource conservation and environmental protection and to overspend on distortionary subsidies to environmentally destructive activities provides ample justification for **earmarked environmental funds.** When such funds are financed through environmental charges or external borrowing, they often become a source of friction with finance ministries that tend to regard them as soft funds, crowding out other higher-return private and public investments.

Financial instruments such as **revolving funds, green funds, relocation incentives and subsidized interest or soft loans** (for projects with significant positive externalities, e.g., reforestation) may be justified as (a) second-best responses to distorted or inefficient capital markets, (b) vehicles for internalizing positive externalities or environmentally minded investors' willingness to pay for socially responsible investments, and (c) instruments for mobilizing additional financial resources for conservation, environmental protection, and sustainable development.

While the instrumental value of financial incentives in a second best world cannot be denied, the first-best policy is the correction of capital market imperfections, efficient budgetary allocations, and full-cost pricing. Financial subsidies, soft loans, subsidized interest rates, and foreign exchange or special funds are too blunt as instruments for the efficient internalization of external social costs.

Liability Systems

This class of instruments aims to induce socially responsible behavior by establishing **legal liability** for (a) natural resource damage, (b) environmental damage, (c) property damage, (d) damage to human health or loss of life, (e) non-compliance to environmental laws and regulations, and (f) non-payment of due taxes, fees or charges. In a sense, all instruments have as an ultimate enforcement incentive, the threat of legal action and the use of the state's coercive powers (for example, if effluent taxes are not paid or an adequate number of emission permits to cover emissions are not purchased); administrative and ultimately legal measures are provided for to ensure compliance. The difference

between liability systems from other instruments (except for enforcement incentives and non-compliance charges) is that the threat of legal action to recover damages is the economic instrument that internalizes the external cost in the first instance. Unlike taxes and charges, that are set at the level of marginal damage cost to alter the relative probability of environmentally harmful products and activities, and unlike environmental bonds and deposit refund systems that internalize ex ante, the environmental risk liability systems assess and recover damages ex post. Yet these systems do have the effect of preventive incentives as long as the expected (certainty equivalent) damage payments exceed the benefits from non-compliance. The frequency with which liability cases are brought to the courts and the magnitude of damages awarded influence ex ante behavior of potentially liable parties.

Liability insurance has emerged as an instrument for pooling and sharing liability risks among liable parties. The incentive effect of liability systems is not significantly dampened as long as the liability insurance premium varies with individual behavior or performance. For example, vehicle accident insurance may vary with the individual's driving habits and/or past accident record. Where potential damages are very large relative to the ability of the individual agent to pay a certain minimum level of damages, liability insurance is mandated by law.

Liability systems are not recommended for developing countries with poorly developed legal systems, or with cultures that very rarely use courts to resolve disputes or award damages (although “liability systems” are not unknown to traditional societies, where the tribal chief or the elders settle disputes and award damages). One particular type of liability system practiced in the U.S., the joint and several liability for hazardous waste sites, is particularly litigation-intensive and cost-ineffective (legal fees rather than cleaning costs account for the bulk of the costs of the so-called Superfund for cleaning hazardous waste sites in the U.S.). This system is clearly unsuitable to developing countries, but even transitional economies with an inherited large number of contaminated sites would do well to avoid burdening their privatization efforts and nascent markets with joint and several liabilities. (For more appropriate alternatives see Panayotou, Bluffstone and Balaban, 1994).

Performance Bonds and Deposit-Refund Systems

Environmental performance bonds and deposit refund systems are economic instruments that aim to shift responsibility for controlling pollution, monitoring, and enforcement to individual producers and consumers who are charged in advance for the potential damage. Often the state is saddled with huge bills for cleaning up oil spills and contaminated land, for collection and treatment of hazardous waste, for reclamation of abandoned land after mining, for reforestation after logging, and for man-made “natural” disasters. In fact, a large portion of public environmental expenditures is for restoration of degraded environments, which could have been prevented or paid for by the polluters or beneficiaries of responsible activities. The government can reduce its share of the clean up and restoration bill (and, in fact, the overall size of the bill), by instituting deposit-refund systems, environmental bonds, bank guarantees for compliance with environmental rules, presumptive charges based on engineering or statistical output-waste coefficients, etc., with refunds for improved efficiency. **Environmental bonds**, for instance, ensure that: (1) resource extracting companies and potential polluters take adequate measures to minimize the environmental damage caused by their activities; (2) they effect clean up and restoration of residual damage in the most cost efficient manner; and (3) adequate funds are available for the clean up of waste and restoration of damaged environments by anyone who fails to comply. Environmental bonds need not be a constraint on economic activity, as they can be invested in interest-bearing accounts or replaced by bank guarantees.

Deposit-refund systems can similarly shift the responsibility for controlling environmental degradation to the producers and consumers of polluting products, who are thereby induced to return the by-products of their production and consumption for recycling or treatment and safe disposal or otherwise to finance their collection and return by others. A great advantage of deposit-refund systems for developing countries is the inducement of a labor-intensive activity (waste collection) in an environment of low-cost, abundant, and underemployed labor. Deposit-refund systems are applicable to a wide range of products and by-products from beverage containers and packaging of car batteries and vehicle hulks, to plastics and hazardous materials. In the absence of such deposit-refund systems, the government has to expend scarce government revenues for their collection or to leave such waste uncollected to litter water bodies and soils, thereby damaging public health and wildlife and harming the country's tourist potential and investment climate.

There are many other ways in which governments can induce the private sector to assume responsibility for waste minimization. For example, industrial associations for specific types of

industries (e.g., agrochemicals, sugar mills, palm oil mills, electroplating plants, etc.) or for specific locations (e.g., around a lake, on a river, on a segment of coast, or in an industrial estate), can be given the choice of attaining a certain ambient level of water or air quality on their own or to be directly regulated and impacted by a government regulatory agency. Experiences in Germany, with factories operating on the Ruhr river, in Thailand with sugar mills on the Tanchin river, and a variety of factories in Japan, suggest that a well-identified community of industries will choose self-regulation and self-enforcement if they are convinced that they cannot otherwise evade environmental regulations.

Induced self-regulation is more efficient and cost effective than direct government regulation because industries know best how to control their own waste, because self-enforcement is induced by a desire to be accepted by other members of the association and by the community, and because the cost of policing and monitoring is significantly reduced and assumed directly by the source. Again, the funds needed for environmental clean up and enforcement of environmental regulations are reduced and generated from among the members of the industrial association in a manner that alters behavior and way of doing business; such is the only sustainable approach to higher growth with less destruction. The government need only monitor ambient quality and impose charges on the association for non-compliance or wave the “threat” of direct regulation. This approach may not work in all situations but it will work in a sufficient number of cases to achieve a substantial reduction in the level of public funding necessary to promote sustainable industrial development. An alternative approach is the establishment of Industrial Environmental Funds through presumptive charges on industries according to expected waste generation and the use of such funds for environmental clean ups carried out by the private sector on a competitive basis. Combined with environmental auditing by accredited auditors, and rebates (or surcharges) for better than (worse than average) performance, such funds can serve both as incentive systems and as financing vehicles of sustainable development.

CHAPTER 4 DEVELOPED COUNTRY EXPERIENCE AND ITS RELEVANCE TO DEVELOPING COUNTRIES

The experience of one country does not readily transfer to another. Particularly problematic is the transfer of developed country experience to developing countries because of differences in the stages of development, and in culture, traditions, and political and administrative infrastructure. Nevertheless, there are lessons to be learned from other country experience that either transcend these differences or at least could be sifted through for relevant elements. With regard to economic instruments, developed countries have relatively longer experience with such instruments which may help developing countries follow more promising routes of experimentation. In this chapter we briefly review developed country experience and examine its applicability to developing country conditions. The main categories of instruments covered in this review are the following: (a) fiscal instruments, (b) charge systems, (c) market creation, and (d) deposit-refund systems.

Fiscal Instruments in Europe

Developed countries, especially in Europe, have a long experience with the application of economic instruments in environmental management. This experience has been mixed, but a general lesson is that fiscal instruments, while effective in generating fiscal revenues, are generally ineffective as incentives for changing behavior unless they are set high enough to alter the relative profitability of inputs, products, technologies and practices. Countries are often reluctant to set taxes and charges high enough to act as economic incentives because of political reasons, resistance by industry or concerns about competitiveness. Among developed countries, only the Netherlands has come close to charging the marginal damage cost of pollution. France lies at the other extreme: charges have been set at less than a quarter of the level necessary to induce a significant change in behavior, and 90% of the charge revenue is returned to the industry as subsidies for investment in pollution abatement technology.

In this section we briefly review the developed country experience (mainly European) with fiscal instruments focusing on (a) effluent charges, (b) product charges, (c) tax differentiation, and (d) subsidies.

Effluent Charges

Effluent charges have been applied in developed countries to air and water waste and to noise pollution. Air emission charges are rare, having been used only in France with rather modest results. The charge was set at 19 ECU per ton of sulfur oxides, which is only 1% of the charge required to meet the European Community directives were they to be attained exclusively through charges. Ninety per cent of the charge revenues is returned to the charge payers as a subsidy for pollution control equipment, and the rest is used to develop new technologies. The performance of this system is limited by the unfeasibility of the collective treatment of air pollutants and the complexity of monitoring when applied to more than one or two pollutants. This system is clearly unsuitable for developing countries with monitoring difficulties.

Several countries—notably France, the Netherlands, and Germany—have used effluent charges to control **water pollution.** France has had such a system since 1969. The effluent charge is levied on all fresh and sea water polluters—both households and industries—and applies to several pollutants such as biochemical oxygen demand (BOD), chemical oxygen (COD), soluble salts, organic/ammonia, nitrogen and phosphorus. Industries are charged on a flat rate set by actual measurement. The system is designed to raise revenues rather than to act as an incentive for waste minimization, as the charge rate is set too low to induce a change in the production process. France's success with effluent charges lies in the acceptance of these charges as a way of doing business. The key has been their gradual introduction of these charges at low levels and on a few pollutants and their progressive escalation to higher levels and wider scope (Hahn, 1989).

In Germany, a water pollution charge was implemented in 1981 with an explicit incentive purpose and a close link to direct regulations. Although the nominal charge per unit of discharge was set at ECU 5.75 in 1981 and raised to 19.20 ECU in 1986, the effective charge varies according to the degree of compliance with standards. For example, a 50% discount is applied when minimum effluent standards are met. Although it is difficult to assess the effectiveness of the system separately from that of direct regulation, there is evidence of substantial incentive effects. Ten per cent of the firms complied with the standards in order to benefit from the charge discount; several large firms treated more than the minimum requirements for economic reasons; one third of the municipalities claimed that the charge system induced them to intensity their water treatment facilities; and the clean technology market grew rapidly (OECD, 1989).

On the other hand, the administrative efficiency is low as over 50% of the revenue is spent on administering the system. The revenue, however, could quadruple with little increase in administrative costs if the charge rate were raised to the optimal level (the average treatment costs). (OECD, 1989) reports that the system was to be adjusted in 1989 to increase the discount on the charge to 100% for a discharge of less than half the minimum standard, and to 80% for the application of “state-of-the-art” techniques for the control of toxic waste.

The Netherlands have a combined effluent user charge system: the Water Boards and firms pay an effluent charge (based on BOD and COD) to the State Water Authority for discharges into state waters; firms and households pay a user charge to Water Boards for discharges in other waters that are treated by the Water Boards. The overall charge is calculated by the Water Boards in order to balance their budgets for water treatment. The individual polluter's charge is based both on volume and concentration. Large polluters are monitored and charged accordingly; medium-sized firms are charged according to a table of coefficients that vary by type of industry; small firms and households are charged a standard fee (one-person households may apply for a reduction). The charge system in the Netherlands has been effective not only in raising substantial revenues to finance water quality improvement, but also in its significant incentive impacts, and in inducing behavioral and technological changes in certain industries such as chemicals, food, beverages, and tobacco. According to OECD (1989), waste pollution was reduced by 70% during 1969-80 and another 10% reduction was expected during the 1980s. Bresser (1983) reports that differences in effluent charges account for 50% to 70% of the variation in pollution abatement among 14 industrial sectors. The success of the Dutch system is attributed to the fact that the charge rates have increased considerably over time (from ECU 4.70 to 17.20 per pollution unit in 1977 to ECU 12.30 - 34.00 in 1985), generating expectations for further increases. In per capita terms the Dutch charges are eight times those of France and 16 times those of Germany. Their administrative costs are also low, ranging from 2% for state charges to 4% to 9% for others. Despite some disagreements about pollution coefficients and industry complaints about the increase in charge rates, the system is well accepted (OECD, 1989).

One area where the Dutch charge system has been less effective and regulations more suitable is the control of heavy metals from diffused sources.

In conclusion, effluent charges for water pollution (in combination with regulatory standards) have been reasonably effective and acceptable in Europe. Where the charge rates were set at relatively high rates and escalated over time, there has been a continuing incentive for firms to minimize waste and to abate it. The charges have also been a major source of revenue for collective water treatment. It is also important to note the need for variability in charges according to source and type of pollutant (i.e., small vs. large, toxic vs. non-toxic).

Effluent charges for water pollution are quite relevant to developing countries that experience heavy pollution loads in rivers flowing through urban and industrial centers. Of the three country experiences reviewed, the Dutch system is the most relevant, not only because it has been very effective and administratively inexpensive but because it takes monitoring and enforcement difficulties into account, differentiating between large, medium, and small firms and households. Similar concepts to those of the Dutch system were used in formulating the proposed Industrial Environmental Fund for Thailand (Panayotou, 1993).

Effluent charges for **solid waste** are rarer than water pollution charges. Belgium imposes a charge of ECU 0.02 - 2.15 per ton of industrial and municipal waste, depending on the type of waste and its treatment before dumping, while exempting recycled wastes. To encourage recycling, Denmark charges ECU 5.20 per ton of “harmful” waste dumped. The Netherlands imposes a progressive charge on surplus manure, which is a major source of acid depositions, eutrophication, and soil pollution. The United States levies ECU 1.85 per dry ton of hazardous waste on waste site operations to finance the restoration of the site after closure. The problem with these simple charge systems for waste is that “low charges would not be effective and high charges would encourage evasive behavior and illegal dumping” (OECD, 1989). Therefore, effluent charges for solid waste are not recommended for developing countries unless they are combined with delivery bonds and auditing (see the proposed Industrial Environmental Fund for Thailand). User charges on waste disposal are preferable, more common, and their use is recommended for developing countries.

Product Charges

One product charge used by many European community countries, such as France, Germany, and Italy, is a charge on lubricant oils. Its effectiveness in terms of waste oil recovered is high in Germany, where it is set at ECU 96 per ton, and low in France, where it is set at ECU 6 per ton. The most remarkable product charge is the Dutch new general fuel charge, which replaces five previous charges. Two thirds of this tax is a surcharge on excise duties applied to mineral oil, and one third is a levy. Its purpose is to raise revenues to finance the environmental programs of the Ministry of the Environment. The incentive value of the **general fuel charge** is low, but it is enhanced with rebates for installation of sulphur dioxide abatement technologies. Administrative costs are low, since they are tied to the excise duties on fuels.

Sweden—and to a lesser extent Norway—has a preference for product charges. Some common charges include charges on batteries, fertilizers and pesticides, non-returnable containers, and oil products. The U.S. has a general feed stock charge on industries using **chemical and other hazardous materials** in their production process in order to finance the “Superfund” for the cleaning up of abandoned hazardous waste sites. The incentive effect of this charge is limited and so is its efficiency, but it is well accepted by the industry.

In conclusion, product charges lack a strong incentive impact. Whatever reduction of waste is accomplished it's because consumption of the product has been discouraged, not because the producers have an incentive to minimize or treat waste. Thus, only prevention through sufficiently high product charges to discourage consumption and/or encourage reuse and recycling of reusable and recyclable material would result in environmental improvement. In contrast, the revenue-raising impacts of these charges is considerable, especially when the demand for the product is price inelastic. The administrative efficiency is also high because product charges are self-enforced. Product charges, despite their drawbacks, have particular relevance to developing countries because they are virtually self-enforced. The low monitoring and enforcement capabilities of developing countries present difficulties for many other economic and regulatory instruments.

Tax Differentiation

Tax differentiation has been used mainly in Europe to reduce **transport-related emissions** by: (a) speeding up the shift from leaded to unleaded gasoline and (b) encouraging clean car sales. As with other charge forms, tax differentials have an incentive effect only to the extent that they are sufficiently large to alter behavior. In Europe, leaded and lead-free gasoline differentials ranged between ECU 0.17 per liter in the Netherlands to ECU 0.47 per liter in Finland. Evidence from Germany shows that a tax differential of ECU 0.034 per liter has resulted in an increase of the market share of leaded gasoline from 11% in 1986 to 28% in 1987. Subsequent reduction of the tax differential to ECU 0.029 in 1987 and ECU 0.024 in 1988 reduces its effectiveness as an incentive. It must be noted, however, that European countries have used tax differentiation as a transitional policy to speed up the implementation of direct regulations of air pollution from vehicles. In terms of transport-related emissions, the general level of gasoline taxes (and hence the general level of gasoline prices) is as important, if not more, as gas tax differentials. For example, the U.S. has traditionally maintained low gas taxes and domestic oil prices below world price levels while Europe and Japan have practised the reverse. This has resulted in significant differences in energy efficiency.

Several European countries introduced tax differentiation during 1985 and 1986 as an instrument for the promotion of cleaner cars to meet existing or forthcoming regulations. Buyers of “cleaner” cars were given a tax advantage paid by buyers of “dirtier” cars. Tax differentiation was based on pollution characteristics, size of vehicle, and/or year of purchase. Evidence from several countries indicates considerable effectiveness of tax differentials as instruments for speeding up the implementation of regulations. In 1986 only 56% of new cars in Germany met stringent emission standards; in 1987 90% of new cars met these regulations and qualified for tax advantages. Similar results are reported for Sweden and the Netherlands.

Two other variants of tax differentiation proposed in the Netherlands warrant mentioning here because of the potential applicability to developing countries: (a) a differential VAT (value added tax) between environmentally “friendly” and “unfriendly” products; and (b) a reduction in the annual road tax on cars and an increase in the indirect tax on car fuels to create a tax differential between light and heavy car users and in order to discourage driving. The latter is thought to have three related benefits: reduction of energy use, pollution, and congestion. The disadvantages are that foreign tourists driving through the Netherlands would face higher costs while residents of border areas would buy fuel abroad. The great advantage of a tax differentiation system is high administrative efficiency because it is integrated into the existing tax system and requires little additional collection and enforcement effort. As such, it is especially relevant to developing countries with low monitoring and enforcement capabilities. The side-effects noted in the case of the Netherlands are of less importance in developing countries. Also, the long-term price elasticity of fuel consumption is likely to be higher in developing countries, and hence indirect taxes on car fuels are likely to discourage car use more than they do in developed countries. Thailand has recently implemented differential leaded and lead-free gasoline taxation with encouraging results.

Subsidies

Most OECD countries, with the exception of the United Kingdom and Australia, have provided some financial assistance for environmental investments by the private sector in the form of grants, soft loans, or tax allowances. The main objectives of such subsidies are:

(a) to speed up the enforcement of direct regulations;

(b) to assist firms, especially small ones, that face cash flow problems or financial difficulties caused by capital investments required by compliance to new regulations;

(c) to support the research, development, and introduction of pollution control equipment and cleaner technologies.

Subsidies are financed from charges, revolving funds, and the general budget. The use of user charges to finance collective pollution-control and treatment facilities is not considered a subsidy; only the part of the expenditures not covered by user charge revenues is considered a (hidden) subsidy. It has been estimated that environmental subsidies in Europe range between 5% and 20% of total environmental investments.

In France, most environmental subsidies are closely linked to charge systems: polluters pay for their emissions, but as much as 90% of the revenues is returned to them as refunds for environmental

investment and other improvements that they make. About 10% goes to finance research and development of new technologies. Subsidies financed from the general budget are found mainly in industrial and household waste-collection and treatment.

In Germany, subsidies are financed mainly from the general budget with the aim of assisting small firms during the transition period and speeding up implementation of new environmental regulations. Revolving funds provide an additional source of financing. Subsidies are given in the form of soft loans to polluters facing strict environmental standards are being held fully accountable for their environmental costs. There is conflicting evidence as to the environmental effectiveness and economic efficiency of these subsidies. While the responsible Federal Ministry claims 100% success in emission reduction, others argue that “subsidies have no incentive impact…, but may only give rise to `windfall profits”' (OECD, 1989). The function of subsidies in speeding up the enforcement of regulations is also disputed. The economic efficiency of subsidies—that is, their contribution to optimal pollution reduction—is also reported to be low, not only because of the windfall profits they give rise to but also because subsidies are not tied to specific environmental outcomes; non-environmental criteria play a role as well. Finally, subsidies are a violation of the polluter-pays principle to the extent that part of the environmental costs are not borne by the polluters, although OECD accepted that subsidies to target groups facing difficulties, especially during well-defined transitional periods, are not in conflict with the principle.

The United States has limited experience with environmental subsidies, which are applied mainly in **waste treatment and noise abatement.** The government subsidy to investment in waste water treatment facilities was initiated in 1956 and has varied over time between 30% and 75%. The U.S. experience indicates that:

(a) with the exception of a few financially strapped communities, subsidies were not indispensable to the waste water treatment programs;

(b) the variation in the level of subsidies over time induced a postponement of investment and of compliance with regulations in expectation of higher subsidies; and

(c) the high subsidy share of investment costs has induced capital-intensive treatment plants with excess capacity (OECD, 1989).

The developed country experience with environmental subsidies suggests the following lessons for developing countries:

(a) the use of subsidies should be minimized, targeted, and of limited duration during the transitional phase;

(b) subsidies should not be escalated, but rather, phased down over time to create incentives for accelerated rather than delayed compliance;

(c) subsidies should not be tied to a particular technology or investment but to specific environmental outcomes (improvements);

(d) for subsidies to be compatible with the polluter pays principle, they should be financed from charges on polluters and given in connection with specific environmental improvements; partial refunding of charges may help secure the industry's cooperation and willingness to pay the charges; and

(e) subsidies from the general budget may be justified for cleaning accumulated hazardous waste prior to the introduction of control policies, for abatement of non-point pollution or waste generated by large numbers of small and dispersed units, and for support of research and development of new pollution abatement and cleaner production technologies.

Environmental subsidies are relevant to developing countries because their industry is dominated by a large number of small, unregistered, dispersed, and fugitive firms that cannot be easily regulated and monitored; nor can effluent charges be collected at reasonable administrative costs. Indirect instruments such as product charges, differential taxes, refundable deposits, and subsidized collection and treatment of residual waste are superior instruments under these circumstances. Similarly, user charges may not fully cover the costs of sanitation and **solid waste collection** services making subsidies unavoidable. Every effort, however, should be made to finance such subsidies from surcharges on related public utilities and property taxes approximating as much as possible the polluter pays and beneficiary pays principles. Finally, in developing countries with little experience in pollution charges, subsidies in the form of refunded charges for environmental

improvements might be indispensable for obtaining the agreement of the industry to the introduction of such charges. The great danger with subsidies in developing (as in developed) countries is that they become institutionalized in public policy and capitalized in the value of economic assets (such as land), resulting in windfall profits or capital gains with little influence on behavior towards more environmentally benign activities and practices.

Charge Systems in Europe and the United States User Charges

User charges are applied to the collection and treatment of municipal solid waste and **wastewater** in the public sewage systems. Virtually all developed countries apply a form of user charge for wastewater. Some, such as Belgium and Denmark, levy user charges only on households. Others, such as the U.K., apply the charge only to firms. Most countries, however, target both firms and households. The most common form of user charge is a flat rate. A few countries such as Canada, Sweden, and the U.S., supplement the flat rate with a water use charge, while others, such as France and the U.K., charge according to water use only (i.e., no basic flat rate). In a few countries, such as Finland, the U.K., and the U.S., user charges for firms are based partially on a flat rate and partially according to pollution load. Only Denmark and Germany levy a user charge according to the volume of wastewater discharged. In some countries, such as Sweden, there is cross-subsidization of households (which pay a low charge) by firms (which pay a high charge). Because in most countries the charge is not on water pollution strength, industries that reduce their water use and hence their wastewater may simply be raising the pollution load. To avert this problem the U.S. has introduced a water-pollution-strength charge, but because of high monitoring costs it is applied only to large dischargers.

User charges for solid waste collection services also exist in virtually every developed country, but only a few provide incentives for waste minimization and recycling. A flat rate charge is usually used for households and a waste-volume-based charge for firms. In Finland, a joint private-public sector chemical waste treatment firm offers its services at a user charge based on the volume and type of waste and transport distance. In the past France has had the only system that provides incentives for waste minimization: a household waste-collection charge that is based on the actual volume of waste that households and firms offer for collection and the unit service costs. Because of problems with invoicing and with the charge base, this system is being increasingly replaced by a household waste-collection tax based on property value. Thus, in the case of user charges there is a clear trade-off between incentive impact and administrative efficiency. User charge systems are generally acceptable and effective, but as structured provide little incentive for waste minimization and recycling. User charges, however, can be made to provide such incentives, if they are based on the quantity and quality of waste for large polluters and if they rely on a simpler system (e.g. waste-collection taxes) for small firms and households. Despite the unimaginative use of user charges in developed countries, the scope of user charges for solid waste collection and other public services is considerable (see sections on solid waste management in developing countries).

Access Charges (Road Pricing)

The traditional response to ***traffic congestion*** has been the building of more roads. An ever increasing demand for road infrastructure combined with budgeting pressures has stimulated the interest in demand management in general and in road pricing in particular. The costs of building new highways is increasingly recovered from revenues collected from road tolls, a form of user charge that serves both as a cost recovery instrument and as a traffic regulator. A major problem with toll highways, however, has been the need for drivers to stop and pay the toll, thus slowing down traffic and negating some of the congestion reduction benefits of the system. In response to this problem, automatic toll and entry fee systems have been developed in Denver, Colorado; Cambridge, England; Bergen, Oslo, and Trondheim, Norway.

Here we will briefly review the automatic toll system in Colorado. Toll highway E-470, the first high-tech toll highway in the U.S., was opened in July 1991. Unlike conventional tolls, E-470 allows the cars to drive through at full speed. The toll booth automatically charges a toll to the driver's credit card by picking up electronic signals from the ID card with which his car is equipped. This toll system has the capacity to alter the charge based on the level of congestion (i.e., to charge higher tolls during rush hours) and thus to regulate and smooth out the flow of traffic. Knowing that a higher toll is charged during rush hours, drivers would tend to take alternative routes or to start earlier/later for

work. Drivers with inflexible schedules or urgent business are then able to use an uncongested highway during rush hours by simply paying a higher toll or using car pools.

The benefits from such a system are many. First, congestion costs in terms of loss of time and fuel are reduced, thus motorists benefit. Second, pollution is reduced because of higher speeds, less time on the road, and fewer cars running (as a result of car pooling). Third, the government raises revenue for maintenance and expansion of road infrastructure. The main objections to the system have to do with the concerns that peoples' movements are thus monitored in violation of individual freedoms. Hong Kong has considered an automatic road toll system and rejected it on these grounds. However, this objection has now been addressed through a technological innovation that automatically deducts charges from the balance on each vehicle's ID card account. An alternative solution is to allow a choice to motorists by providing separately manned toll booths for those who prefer not to use the electronic toll system, just as they are provided today for those who do not have exact change.

Road pricing in general, and the electronic toll system in particular, should be applicable in any country regardless of the level of development. Because in developing countries car owners belong to the elite and the upper middle class, a road pricing system would not only be efficient but also distributionally progressive; especially if the revenue from tolls is used to subsidize an efficient mass transit system which is less polluting and more affordable by low income groups.

Market Creation From Tradeable Emission Permits in the United States to Individual Tradeable Fishing Quotas in New Zealand

Tradeable Emission Permits

The major applications of tradeable emission permits have been in the U.S.: (a) trading of emission rights of pollutants regulated under the Clean Air Act; (b) inter-refinery trading of lead credits; and (c) trading of permits for water pollution control. Three additional uses are being initiated or actively considered: (a) acid rain; (b) CFCs; and (c) newsprint.

Interestingly, the U.S. trading of emission rights arose from an attempt to implement strict emission regulations, which in many areas could not be met within the set timetable or could be met only at substantial opportunity cost in terms of foregone economic growth. When it was realized that many states could not meet the planned emission reduction, the EPA formulated an offset policy by which new and modified emission sources were allowed in “non-attainment areas” as long as any additional emissions were offset by reductions in existing sources. This led to the 1986 Emissions Trading Policy Statement, which covers several pollutants such as **carbon monoxide,** sulfur dioxide, particulates, VOCs, and nitrogen oxides. The U.S. emissions trading program has several elements. The “netting” or “bubble” element allows “trade” of emission reductions among different sources within a firm, as long as the combined emissions under the “bubble” are within the allowable limit. The “offset” element allows firms to trade emission credits between existing and new sources within a firm and among firms, new sources of emissions can be constructed as long as the new emissions are (more than) offset by a reduction of emissions from existing sources. Finally, the “banking” element allows firms to accumulate and store emission reduction credits for future use or sale.

It is estimated that 5,000 to 12,000 trades have taken place within firms for the modification or expansion of plants (Hahn and Hester, 1989) and 2,500 trades (some among different firms) for the locating of plants in “non-attainment” areas (Dudek and Palmisan, 1988). Large companies such as Amco, Dupont, USX, and 3M have traded emission credits, and a relatively active market for such trades has developed (Stavins, 1991). It is estimated that the U.S. emissions trading program, despite its many limitations, has saved participating firms between $5 and $12 billion in compliance costs (Stavins, 1991) by affording them greater flexibility in meeting emission limits. These are substantial savings considering that only 1% of potentially tradeable emissions was actually traded and that virtually all trading took place within firms rather than between firms where the highest cost savings are likely to be found.

The U.S. Emissions Trading Program has several weaknesses that limit participation and interfirm trading. First, states are encouraged but not required to allow trading in their implementation of the Clean Air Act. Second, inter-firm trades must be approved by the regulators who are not accustomed to trading practices. Third, there is uncertainty about the program's future and about the content and nature of rights that are being traded.

Despite these limitations, the Emissions Trading Program fared well in both environmental effectiveness and economic efficiency. According to Rehbinder and Stewart (1985), trading has produced at least as high an ambient air quality as direct regulations and at a much lower cost (as the savings of $5-12 billion reported above suggests). In contrast to "technology forcing" implied by the strict technology requirements of the Clean Air Act, emissions trading allows plant operators the flexibility to choose the technologies most suitable to their own circumstances, to come up with their own inventive technological solutions, and to go beyond the minimum requirements of the imposed standards to control pollution for profit.

An outcome of emissions trading of particular relevance to developing countries is that it allowed the construction of a large number of new plants in highly polluted areas without increasing pollution levels; an outcome that would not have been possible with direct regulations. (The substantial data and monitoring requirements of emissions trading and their implication for developing countries will be addressed below.) Developing countries cannot afford to retard their industrialization and economic development through inflexible and costly regulations or mandated technology standards. Emissions trading offers industrial firms the option to avoid meeting stringent emission standards for new plants by reducing emissions in existing plants or purchasing emission credits from other firms that can reduce their emissions at lower costs. On the negative side, the administrative costs of the U.S. emissions trading system have been high because the system evolved from efforts to enforce direct regulations rather than from a clear definition and allocation of pollution rights. The replacement of the requirement for approval of abatement technologies by the requirement for approval of emissions trading transactions did not reduce the involvement of the regulators and the administrative costs. It did, however, shift decisions about the choice of abatement technology and its location from regulators to plant operators.

In developing countries, an emissions trading system would be further limited by the high monitoring of, and transaction costs between, a large number of small firms, many of which are unregistered. Yet there is no reason why an emissions trading system could not be applied to public utilities, multinationals, large local firms, and industrial estates, while small sources may be controlled by a system that targets fuel use rather than emissions. The main limitation is that emissions trading does not apply to more than one pollutant simultaneously, unless some equivalence index is developed (OECD, 1991).

Another environmental market creation was the EPA **lead** trading program during 1982-87. Gasoline refiners were given the flexibility to produce gasoline with a lower or higher lead content than the level mandated by the standard: those with lower-than-standard lead content accumulated lead credits that they could sell or bank for future use; those with higher-than-standard lead content could use past lead credits or purchase them from other firms. About 15% of total lead rights were traded and 35% were banked and traded or used later on. The EPA estimates the annual savings from lead trading to be US$200 million. This means that the lead standard mandated by direct regulations was attained at a cost that was 20% lower with trading than without trading (EPA 1985). There are good reasons why lead trading has been more successful than other emissions trading. First, there was consensus about the objective: the phasing out of lead in gasoline. Second, lead in gasoline can be easily monitored both technically and administratively, involving a relatively small number of refineries. Third, the content of the right that was traded was well-defined, the programs had a known fixed life, and no complex approval process for the trading was required.

Tradeable permit programs have also been used in controlling **water pollution** in the U.S. There are two notable cases: (a) the Wisconsin Fox River water permits for point pollution sources and (b) the Colorado Dillon Reservoir water permits for non-point pollution sources.

In the early 1980s, the state of Wisconsin issued discharge permits to 14 paper mills and four wastewater treatment plants discharging effluents into the Fox River. The permits were issued only for reductions of BOD discharges exceeding the levels required by treatment standards. Trading of permits was allowed in order to give firms more flexibility in controlling and treating their effluents. Despite estimates of potential cost savings of up to US$7 million per year, no trading has taken place thus far. The reasons are many and varied. First, the oligopolistic structure of the pulp and paper industry and the regulated public utility status of the waste treatment plants limit competition. Second, the required justification of the need for permits and the requirement for modification or re-issuance of permits after every transaction create high transaction costs that discourage the trading of permits. Third, the five-year fixed life of the permits and the lack of an established process for reallocation create uncertainty about both the value of the permits and the effect of trading on their future allocation (Hahn, 1991).

Somewhat more promising is the permit trading program between point and non-point pollution sources at the Dillon Reservoir in Colorado. Under this system point sources are allowed to treat their effluents by less than required (drinking water) standards in exchange for reduction or treatment of non-point pollution sources. In the Dillon Reservoir case, the point sources are publicly owned sewage treatment plants, and the non-point sources are agricultural, recreational, and urban activities. The scope for trading arises from the lower marginal costs of treating discharges from non-point sources to some level (say from zero to 60% or 70%) compared to treating point discharges from 95%-98%, which requires new purification facilities. The fact that trading in this system is between the waste treatment facilities and the water authorities implies low transaction costs and hence easier implementation. Despite EPA estimates of cost savings of approximately $1 million a year, no trading has taken place since the program's inception in 1984.

The U.S. is currently considering the use of a tradeable permits system to control acid rain and to promote newspaper recycling. The SO_2 allowance trading system sets an 8.9 million ton per year national cap on SO_2 emissions from utilities beginning in 2000 to be reached in two phases (Joskow, 1991). 8.9 million SO_2 allowances (each allowance representing a ton of SO_2) will be issued and allocated freely to existing sources based on baseline fuel use and a specified emissions rate. (The available allowance for Phase II units is ratcheted down to meet the national cap on SO_2 emissions by the year 2000). To comply with the statute, each existing unit must hold allowances equal to or greater than their emissions during the year. Allowances can be traded within and between utilities as well as banked for future use. Thus, by allowing low-cost abaters to “over-comply” and sell surplus allowances and high-cost abaters to “under-comply” and purchase additional allowances to cover their deficit, the system aims to minimize the overall cost of compliance with the national SO_2 cap. New sources must purchase allowances from existing sources. The estimated value of an allowance is US$400-US$700, although the actual value would be determined by the market. Firms found to produce excess emissions will have to purchase permits as well as pay a penalty of US$2,000 per ton. Except for monitoring compliance and a small EPA auction and fixed-price sale (programs involving less than 3% of Phase II allowances), the EPA's involvement in private market arrangements will be minimal. For this very reason the program is expected to work better than earlier emission trading programs. Another reason is that monitoring technologies for SO_2 exist and firms are required to install continuous emission monitors.

The U.S. Congress is considering a marketable permit system to stimulate the recycling of old newspapers. The bill under consideration requires producers and importers of newsprint to use an increasing percentage of recycled fibers each year and hence a diminishing percentage of virgin pulp. A system of marketable permits or credits would help the individual producers and importers meet the industry-wide percentage of recycled fiber content at a lower cost than uniform percentages. Dinan (1992) has studied the proposed system and concluded that the level of production under a percentage-based permit system would be higher than under a quantity-based system and that the cost savings are potentially high but their realization depends on: (a) level of compliance; (b) competitiveness of the permit market; (c) transaction costs; and (d) the certainty regarding the legitimacy of permits and the future prospects of the market for permits.

At a somewhat superficial level, tradeable emission permits (TEP) appear to have little applicability to developing countries. First, TEPs involve trading pollution rights in countries where even commodities are not freely traded in undistorted, competitive markets. Second, the system of TEPs seems to require a level of market sophistication and abstraction that does not exist in many developing countries. More damagingly, TEPs seem to require large data requirements and monitoring capabilities that are very scarce in developing countries. All of these criticisms are valid if developing countries attempt to copy the U.S. system of TEPs which is clearly overregulated and cumbersome. The concept that is most useful to developing countries is the concept of earning and trading pollution credits among industries of differential abatement costs. First, because production costs vary more widely among developing country firms than among firms in developed countries, the gains from trading pollution credits are likely to be proportionately larger. Second, because the industry in developing countries is undergoing faster growth and structural change and has a wider scope for efficiency improvements than its developed country counterparts, the introduction of TEPs is more likely to lead to efficiency gains and structural changes than to increased cost of production and shifting of economic growth, especially if it is phased in over a period of 5-10 years. A developing country can begin by introducing TEPs for large domestic and foreign firms as well as public utilities. At a second stage, trades can also be established between point and non-point sources of pollution. By working with local industry associations, governments can reduce monitoring and enforcement

costs. The application of these elements of the TEP are found in proposed pollution-abatement credit trading for Indonesia (see below) in support of the existing, but unmet, regulatory standards.

Tradeable Fishing Quotas

Like most of the world's **fisheries,** New Zealand suffered from excess fishing efforts and overfishing which threatened the resource. To reduce overfishing, the New Zealand government issued tradeable catch quotas on all fish harvested, allocated to individual fishermen according to their historical catches. Fees were imposed on the recipients of these quotas, and the revenues generated were used to buy back quotas from fishermen who would rather have the money than the right to fish their allocated quota. Fishermen were asked to indicate the price at which they were willing to sell their quotas and leave the industry, the government bought back the quotas from those fishermen who were willing to sell at the lowest price until the desired level of fishing effort reduction was reached. Since the quotas were also tradeable among fishermen, they began to be transferred to the most efficient fishermen, ensuring that the aggregate fishing quota was caught at minimum cost. Those who left the fishery by selling their quotas to other fishermen or the government did so voluntarily and were fully compensated. Thus, the scheme accomplished four objectives: (a) protection of the resource, (b) increased efficiency (maximization of fishery rents), (c) fairness, and (d) self-financing (from fees on quotes rather than from the government budget).

For these reasons, the system of individual tradeable catch quotas is of particular relevance and applicability to developing countries with heavily overexploited fisheries. They can be combined with fee-financed retraining and relocation programs to encourage surplus fishermen to sell their quotas and take up alternative occupations. A problem arises when unemployment and underemployment in the rest of the economy are widespread since few fishermen would be willing to sell their catch quotas and exit the fishery if employment alternatives are not available. While under these circumstances a larger than normal level of fishing effort is justified, maximizing rents and distributing them according to pre-assigned resource shares to existing fishermen is preferable to allowing overfishing to continue unchecked.

Deposit Refund Systems in the U.S. and Europe

Deposit-refund systems on **beverage containers** combined with product charges on non-reusable containers have been operating successfully in Finland, Norway, and Sweden. The percentage of containers returned is 90% for beer and soft drinks and 70%-80% for wine and liquor, while the market share of non-returnable bottles is kept small (less than 5% in Finland). Similarly, successful deposit-refund systems for beverage containers also operate in many states in the U.S. There is evidence to suggest that consumers are responsive to the level of the deposit. For example, in 1983 Sweden introduced a deposit of ECU 0.04 on aluminum beverage cans, which resulted in the return of 60% to 70% of the cans. In 1987, the government doubled the deposit (which by that time had lost part of its real value to inflation), and in response 80% of the cans were returned. The success with deposit-refund systems has encouraged several European countries to extend the system to other products such as batteries, car hulks, and pesticide residues. Denmark and the Netherlands introduced refundable deposits for batteries with a high content of cadmium and mercury to control soil contamination. A deposit-refund system for car batteries has been introduced or is being considered in several European countries and the U.S.

Norway and Sweden have introduced deposit refund systems for **car hulks** since the mid-to-late 1970s to reduce solid waste and visual pollution and to promote the reuse of materials. The system worked well in Norway and poorly in Sweden for a good reason. In Norway the deposit in 1988 was ECU 130 per vehicle, while in Sweden it was only ECU 42. While in both countries a larger amount was refunded when the hulk was delivered, in Sweden the deposit and the refund were lower than the cost of scrapping. Thus, a much smaller percentage of disused cars was returned in Sweden than in Norway (90% to 99%).

Lastly, there is an interesting Dutch proposal for extending the deposit-refund concept to various polluting **chemicals** such as cadmium, mercury, etc. The deposit would be paid by the producer or the importer of the substance; it would then be passed on to the user of the products that contain the substance and be refunded to the final user (or exporter) when the product is disposed or exported. Producers of products containing the substance could also be eligible for a refund of any waste of the substance they return or dispose of safely. Thus, the deposit-refund system is gradually expanding from an instrument of limited scope (mainly beverage containers) into a more generic instrument that

can be used at the micro level by industry to limit environmental liability risks (as in the case of hazardous chemicals) and at the macro level by policy-makers to transform the current linear production process into a more ecologically sound circular flow.

The experience of developed countries indicates that deposit-refund systems are cost-effective instruments for reducing littering and waste disposal costs and for conserving material inputs. In the case of beverage containers, the relative price increase of the product as a result of the deposit may be more important than the absolute level of the deposit, while in the case of car hulks the latter appears to be important in relation to the scrapping price. Deposit-refund systems are compatible with the polluter pays principle and have high administrative efficiency because they require no monitoring or collection costs, especially when they are operated by the private companies that produce and distribute the products in the first place.

Deposit-refund systems are of particular relevance to developing countries for several reasons:

(a) the high administrative efficiency (self-enforcement) of deposit-refund is a great advantage for countries with administrative constraints and limited enforcement capability;

(b) the low opportunity cost of labor in developing countries implies that even small deposits would generate an active collection activity that would have both economic and environment benefits;

(c) because the users of batteries, cars, and products with heavy packaging are better off than the waste collectors and scavengers, deposit-refund systems would have positive distributional implications as long as the deposits are not set very high and are extended to a great variety of waste products; and

(d) finally, since most toxic and hazardous substances are imported, it might be administratively simple (reduced audit requirements) to impose a deposit at the import point and refund it to the final users or exporters.

Conclusion

Developed countries, even those that think of themselves as free market economies, have relied on command and control regulations for the protection of the environment. It is only recently that there has been a trend towards increased use of market-based incentives to achieve environmental objectives. This shift, which is still in its early, largely experimental phase, has been prompted by four factors: (a) the lackluster performance of regulations in achieving the objectives of environmental management; (b) the high costs of administration, monitoring and enforcement of regulations as well as the high cost of compliance to regulations; (c) the need to raise revenues to pay for these costs as well as the costs of residual clean up, which have been substantial; and (d) growing evidence that market-based incentives might accomplish the same benefits at lower costs.

In a 1989 OECD survey of economic instruments used for environmental protection, at least 14 OECD countries employed between one and 20 such instruments with Germany, Sweden, and the Netherlands being in the lead. A total of 151 instruments were in operation with approximately half being charges and a third subsidies, with a variety of other instruments such as deposit-refund systems, market creation, and enforcement incentives making up the balance. It must be noted, however, that there are hardly any cases of economic incentives actually replacing regulations; i.e., they have been introduced in parallell, supplementary to regulation with the primary aim of collecting revenues rather than altering behavior in favor of environmentally less destructive activities and practices. The trend, however, is towards increased reliance on economic incentives as instruments of behavior modification. There has also been a trend towards the increased use of instruments such as charges, market creation, deposit-refund systems, and a declining use of subsidies.

The developed country experience with economic incentives is mixed but encouraging, and is replete with lessons for developing countries. One should not look for economic instruments that have succeeded in developed countries to transfer wholesale to developing countries, but rather for lessons that would help avoid the pitfalls that lie ahead. Ultimately, it is a combination of lessons from developed (and developing) country experience and an accommodation of local conditions and realities that will indicate which economic instrument in what form might be applicable. A number of developing countries have already experimented with economic incentives that support regulatory standards, and their experience is of particular relevance to other developing countries contemplating

the use of economic incentives. In the following chapter we review the experience of developing countries with economic instruments.

CHAPTER 5 DEVELOPING COUNTRY EXPERIENCE

Contrary to conventional wisdom, economic instruments are neither foreign to non-Western cultures nor new to developing countries. Traditional societies, especially in developing countries, have a wealth of customary use rights, communal management systems, and customs that provide incentives for efficient use and management of natural resources. These range from water rights in India, to communal forests and land rights in Papua New Guinea, to customary fishing rights in Brazil, Sri Lanka, and the Cote d'Ivoire.

These systems, far from being outdated, contain valuable lessons and essential elements for the design of effective modern systems of managing natural resources in developing countries. Customary communal rights over resources is a dynamic balance between the diseconomies of collective management and the gains from internalization of externalities. While many of these traditional systems did not withstand the test of time and others are undergoing intense pressure from population growth, new markets, and modern technologies, they nevertheless act as prototypes of management systems that are attuned with the local cultures and provide insights into the design of modern systems of natural resource management in non-Western societies.

The developing country experience is not limited to customary use rights for communal resources. Private water rights in India provide incentives for efficient management of increasingly scarce water resources. Concession bidding, forest fees, timber taxes, and environmental bonds are employed in West and Central Africa to promote sustainable forest management. As early as the mid-seventies Malaysia introduced a system of effluent charges for its palm oil and rubber industries, and Singapore, still a developing country at the time, instituted marginal cost pricing of access to the city center to combat traffic congestion. More recently, China introduced industrial discharge permits and emission charges, which double or triple when the allowable discharge standard is exceeded. Turkey has effectively used relocation incentives for urban-based industry. Chile has instituted both tradeable emission permits and tradeable water rights, and Puerto Rico used transferable development rights for coastal conservation. Costa Rica introduced biodiversity prospecting rights and tradeable reforestation tax credits and is currently experimenting with internationally tradeable development rights and carbon offsets. Virtually all Eastern European countries introduced pollution charges, and some of them (Poland and Lithuania) are in the process of experimenting with tradeable emission permits for industrial pollutants. The rapidly accumulating experience of these countries in the use of economic instruments is of particular relevance to other developing or transitional economies contemplating the introduction of a more market-based approach to environmental management. In this chapter we review developing country applications of economic instruments in a number of sectors.

Fisheries Management: The Experiences of Brazil, the Cote d'Ivoire and Sri Lanka with Customary Fishing Rights

Efforts to regulate fishing and prevent overfishing have ranged from quantitative controls (such as catch quotas) to area controls (such as closed areas and seasons) to economic instruments (such as taxes on catch or effort and fishing licensing schemes). Traditional fishing communities in a number of developing countries have solved the problem of over-fishing through customary territorial rights, which combine economic incentives and internally imposed quantitative controls sanctioned by the community's social organization.

Resource allocation through territorial rights—such as leasehold arrangements, franchises, or allocations of ownership over an area or a stock—aims at creating the appropriate environment for self-management through the establishment of private or community “ownership” over common property resources. The “owners” of the resource having an interest in its current and future productivity would be inclined to control fishing effort so as to maximize the net benefits from the resource in much the same way as farmers regulate their farming activities to maximize the returns from their land. For such a system to be workable, however, those allocated rights to the resource should not only be in a position to deny access to others, but they should also clearly perceive that their actions have a direct and pronounced effect on the state and productivity of their portion of the resource (and hence on their future profits).

The above conditions are certainly met in the case of sedentary or slightly mobile resources, such as seaweed and oyster and clam beds, and in the case of resources within well-defined geographical areas such as tidal lands, swamps, self-contained bays, lagoons, and river estuaries. Even with more mobile resources (like crustaceans) and open areas (like coastal waters) there is a possibility of dividing up the resource as long as the fish displacements and migrations between portions are not sufficient to obscure the connection between the “owner's” current actions and his/her future profits. The revival and rejuvenation of traditional community rights over coastal resources offer, perhaps the best possible management option for scattered, remote, and fluid small-scale fisheries.

There are several examples of territorial rights in traditional fisheries in countries as diverse as Brazil, the Ivory Coast, and Sri Lanka. Canoe fishermen operating in a river estuary in Valencia, eastern Brazil, succeeded through a rather complex system of zoning and timing based on the lunar-tide cycle to control internal population pressures and set limits on the intensity of fishing through access limitations, which established fishing as a reliable long-term occupation. Although the resource moved with the tide, the fishermen were able to map out its distribution in time and space and establish “temporary territorial rights which (could be) converted into long-standing territorial claims”. Competition between different fishing methods was eliminated through the zoning that had matched fishing methods and fishing grounds according to the effect of the tide cycle on their efficiency. This had a “boat-spacing” effect. Competition between the same type of gear was reduced through the selection of fishing spots (which had both a spatial and a temporal dimension) by individual captains on the basis of their knowledge of the tide movements and the fishing grounds. Although it was not unlikely for two or more captains to select the same fishing spot, the first to reach the spot had a temporary territorial claim. In the absence of clear-cut prior claims, lots were drawn. What prevented a common-property type of race for the premium fishing spots was a community ethic for captains to anticipate and avoid competitive encounters in deciding where to fish each day. This resulted in a situation where a limited number of captains owned “chunks of the lunar-tide fishing space,” exercised deliberate control over the “opportunity structure of fishing,” and passed their skills to a limited number of apprentices. Thus, the fishermen on their own were able to stabilize their production system, set limits on the intensity of fishing, and resolve inter-gear conflicts through a system of temporary territorial claims.

Sri Lankan coastal fisheries have a history of traditional property rights in the form of rights of access and closed communities. In earlier times, beach seine owners controlled the access to coastal waters and had associated fishing rights that, along with other property, were subject to bilateral inheritance (by descent or marriage). Although at the start each beach seine owner had his own beach for which he had exclusive rights to operate, each of his children had only a fraction, not of his beach, but of his right to fish off the beach along with his brothers and brothers-in-law. While there was no limit to the number of nets that anyone holding rights to access could have constructed, the fishermen on a given beach, being a single kinship group, refrained from constructing additional nets unless they could bring in a catch whose value would have been higher than the cost of the net. That is, they acted as a single economic unit.

Sri Lankan coastal fishing villages are generally “closed” communities in the sense that persons from outside the village are not allowed access to the fishing grounds of the community. Outsiders are not allowed to anchor or beach fishing boats along the shoreline of the community, and labor is not recruited from outside the village. These restrictions on entry help to explain why Sri Lankan coastal fishermen, unlike many other small-scale fishermen in Asia, earn incomes appreciably above their opportunity costs.

Another example of the stark contrast between the situation of a fishery under open access and that of a fishery with traditional fishing rights is provided by the case of two lagoon fisheries in the Cote d'Ivoire (S.M. Garcia, pers. comm.). In Lagoon Ebrie near Abidjan, traditional customary rights of fishermen operating fixed gears broke down following the introduction of mobile gears, such as purse seines, by outsiders (mainly town investors). The Ebrie fishery is now overcapitalized and heavily overexploited in both the biological and economic sense, as evidenced by the small size of fish caught and the relatively low incomes of fishermen.

In contrast, the rather isolated fishery of Lagoon Tagba, over 100 kilometers from Abidjan, is still controlled by a limited number of chiefs (fishing team leaders) who have knowledge of the biological features of the resource and are enforcing traditional regulations on mesh size and on fishing in spawning areas. Though several tribes operate on the lagoon, the limited migration of catfish (the main species exploited) permits each community to manage its own portion of the lagoon. In the late 1960s a severe conflict arose between fishermen from neighboring countries and local fishermen

when the outsiders attempted to introduce purse-seine fishing to the lagoon. The latter managed to capture the purse-seine nets, but they did not use them themselves. Instead, they piled them up as a warning against similar attempts in the future. With so jealously guarded territorial rights, it is no wonder that local fishermen are reported to enjoy relatively high incomes and no surplus labor is evident. The fishermen also claim that the size of fish caught has not changed much in living memory.

Forest Management: From Tenurial Incentives in Southeast Asia to Economic Incentives in West and Central Africa

Most countries have responded to market pressure for secure ownership of resources by imposing a new system of private or state ownership, disregarding customary community-based use rights to forest resources by the state. This deprived communities of any incentive to practice forest protection and sustainable forest management and led to encroachment and unsustainable harvesting practices (Panayotou and Ashton, 1992). Papua New Guinea is one of a few countries that have formally recognized customary community rights over land and forest resources. **Papua New Guinea's** land law builds upon the customs governing its communally held land. The country's Land Ordinance Act calls for local mediators and land courts to base settlements on existing principles of communal ownership. Consequently, 97% of the land remains communal, has been neither surveyed nor registered, and is governed by local custom (Cooter).

This communal tenure seems to provide clearer ownership rights, with all their environmental and market implications, than private ownership. Settlements that convert communal land to freehold are often later disputed, with reversion back to customary ownership a frequent outcome. Yet, unlike the reality of state-owned land in other developing countries, communal land in Papua New Guinea is neither unowned nor public. Rather, the bundle of rights deemed “ownership” in the West does not reside in one part. For example, individual families hold the right to farm plots of land indefinitely, but the right to trade them resides in the clan (Cooter).

In marked contrast to much of the developing world, only six million of Papua New Guinea's 46 million hectares of forest land have been converted to other uses (Australian UNESCO Committee, 1976). This should come as no surprise since those who control the land have an interest in the sustainable, productive use of its forest. Rather than dealing with a distant government in need of quick revenues and foreign exchange, companies seeking logging rights must negotiate directly with those who have secure tenure and who use the land not only to farm, but to gather fruit, hunt, and collect materials for clothing, buildings, and weapons (HIID 1988, Australian UNESCO Committee, 1976). Because the communal tenure patterns provide an entitlement to all clan members, individuals have little incentive to sacrifice future value for current use. Two conclusions may be derived from the Papua New Guinea experience with communal forest tenure:

(a) Basing land law upon customary communal tenure patterns can be a viable adaptation to the requirements of a market economy;

(b) Communal tenure may prevent deforestation more effectively than either state or private ownership if it provides an entitlement and secure tenure to a group that benefits from a forest's sustainable use.

In an effort to reverse past policies, the Philippines have recently granted 25-year communal forest leases through a Community Forest Stewardship Agreement between communities and the Forest Management Bureau. The lease is renewable for an additional 25-year period. The community undertakes the responsibility to protect the remaining forest area in exchange for legalization of the community's occupation and use of the area and government assistance in keeping migrants out of the communal area. Fifteen agreements covering an area of 44,221 ha were reported by the end of 1990. While it is too early to evaluate the program, benefits are reported in the form of: (a) sustainable use of land and forests within the leased area, and (b) reduction of encroachment by migrant farmers (Lynch, 1991). Despite the relative success of the program, the Philippine Government is not yet prepared to increase the incentives for sustainable forest management by recognizing ancestral land ownership. (Sinesio, Mariano, et al. 1987).

Logging concessions in tropical forests are usually awarded through a long administrative process, following negotiations with logging companies, or in an arbitrary fashion that invites corruption. The concession area is typically too large to be protected and managed efficiently and the duration of the conversion is typically too short to encourage careful harvesting and regeneration for a second crop. Forest fees and taxes are generally too low to capture timber rents and to internalize the negative externalities of logging. When forest taxation provides any incentive at all, it is a perverse one; for

example, logging taxes are based on the quantity of merchantable timber removed (rather than on the timber on the site), thus encouraging high grading and damage to the remaining trees. Forest management and regeneration are not made in the interest of the concessionaire but prescribed through regulations (such as minimum diameter, maximum allowable cut, selective cutting, and replanting requirements) that are rarely monitored or enforced.

In recent years, a number of West and Central African countries began introducing economic incentives for improved forest management. In the **Congo** in newly opened areas for logging and in areas where existing concessions are canceled or returned, concessions are allocated by bidding. Bidders submit a bid per cubic meter for the annual volume available for cutting (Egli, 1990). Côte d'Ivoire has also introduced bidding for new logging concessions and **Ghana** has agreed to do the same (World Bank, 1988). The **Côte d'Ivoire** government in early 1991 auctioned log export rights: 30 out of 40 registered bidders participated, 20 were successful and the average sale price was 25% higher than the administratively set price (Chausse, 1991). When there is sufficient competition, bidding ensures: (a) that concessions go to the most efficient and productive operation; and (b) that the government or community that owns the resource extracts the maximum amount of revenues (rents). The bidding price also provides a market based indicator for adjusting forest fees to their correct levels—even for concessions that cannot be allocated by bidding.

The system could be improved further by: (a) replacing logging concessions with forest management concessions; (b) using sealed tender; (c) including technical competence among the allocation criteria; (d) entrusting the bidding procedure to an independent auctioneer; (e) opening the concession bid to local communities and NGOs as well as local and international firms; (f) auctioning the concessions in small but manageable units and making them transferable; and (g) making concessions sufficiently long to internalize the value of the next crop, with a review every five years to ensure satisfactory performance (Grut et al., 1991).

Economic incentives may also be introduced to support the regulation and management of concessions. For example, pre-payment of forest fees or deposit of refundable performance bonds may help avoid logging damage and encourage regeneration. An interesting performance or compliance incentive is the “interim concession license” (Lettre d'Intention) introduced in **Zaire** in 1984 to weed out speculators acquiring large concessions without making the necessary investments in forest inventory and efficient harvesting and processing. The interim license requires the satisfactory completion of 20 elements (specified in the application file) before it can be converted into a full concession license. If the concessionaire does not make the necessary investments within three years, the interim license is canceled. Since the applicants are required to pay in advance for inventories of their prospective concession areas, they are more likely to take their responsibilities seriously.

Another innovative incentive is the “deforestation tax” levied on land clearing in public forests by the **Central African Republic**. It ranges from US $170 to US $500 per ha, depending on the type of public forest land (Egli, 1990). To the extent that the deforestation tax reflects the foregone non-timber values from logging, it acts as an economic incentive to reduce deforestation (Grut, 1991).

Water Resource Management: From Water Pricing in China to Water Rights in Chile

From India to Morocco to Botswana, free or heavily subsidized irrigation water obstructs market signals, encouraging farmers to use the resource beyond its economic (or agricultural) optimum and stifling incentives to invest in improvements and maintenance of existing dams that are often plagued by poor drainage and inefficient distribution systems. In Bangladesh, Nepal, and Thailand, total costs were at least 1000% of revenues collected.

Cheap water often becomes a substitute for other inputs. Over-irrigation by farmers nearest to the water source leads to water logging, salinization, and alkalization. Meanwhile, those less conveniently located are forced to rely on sporadic and sparse water. A study of **Pakistan's** irrigation systems found that 73% of farmers surveyed complained of insufficient water supplies, while farmers close to the water source of the same system were overwatering. The consequences are reduced crop yields, loss of irrigated lands, and increased salt loadings of return flows and aquifers. Downstream effects include the erosion and siltation of estuaries and deltas.

Water subsidies encourage farmers to treat water as an abundant resource when it is in fact scarce. With no water rights, and no effective water user associations or other mechanisms to allocate water efficiently, water scarcity does not register. Indeed, water charges do not reflect the increasing

opportunity cost due to increasing scarcity. As long as farmers do not bear the true cost of water, however, they will be unlikely to appreciate its scarcity or the problems that arise with overuse. Until they receive clear market signals indicating otherwise, they will continue to use water wastefully. Beyond the less apparent economic costs, there is an absence of effective financial cost recovery mechanisms. Even at low maintenance levels only a fraction of operation and maintenance costs are covered by the revenues collected by water users. For example, revenues cover 20% of costs in **Bangladesh**, 27% in **Thailand**, and 60% in **Nepal**. If capital costs are included, water charges often cover only 10% to 20% of costs. It is ironic that capitalist economies such as those of Pakistan and Thailand failed to price irrigation water, while the centrally planned socialist economy of China did not.

In July 1985, the People's Republic of **China** took an important first step towards promoting greater efficiency in irrigation water usage. The Chinese government instituted agricultural policy reforms which invested a greater degree of financial and managerial autonomy in provincial water management agencies. The policy emphasized “water as a commodity rather than a gift of nature and clearly attributed wasteful consumption and the imbalance between supply and demand to irrationally low water charges” (SOURCE). As a result, irrigation water is priced more closely to what it actually costs, and problems associated with overuse and inefficient distribution have diminished. Irrigation service fees are charged at levels to cover operation, maintenance, and amortization of capital costs. Beginning in 1980 the government switched from financing systems with grants to providing loans. The move provided an extra incentive for water management agencies to collect higher water fees. In general, water charges are determined by what the water actually costs for different uses. For example, charges may vary according to season, and in very dry areas progressive water pricing schemes have been adopted to reflect scarcity.

In Hungxian County, for example, farmers reported a more reliable water supply and were willing to pay more for the guaranteed supply. Management is often further decentralized when a local agency purchases water wholesale and sells it in bulk to smaller water user associations responsible for distribution to farmers. These smaller groups strengthen the bond between the water-user and the supplier who must recover costs.

Farmers have begun to irrigate their crops more efficiently, and water use per hectare has declined. Decentralized management has led to more efficient distribution through practices such as distributing water according to land area, levying water charges on a volumetric basis rather than charging a flat rate, and preparing distribution plans in advance. Crop production has improved, with China producing twice as much as similarly irrigated crops in India.

Chile has both a system of tradeable water rights and a full-cost pricing policy towards water (Hartje et. al., 1994). Like most other countries in the world, Chile considers water as a national resource, yet individuals are granted perpetual, irreversible, and freely tradeable water use rights independent of land ownership and use. Water use rights are defined for a fixed quantity per unit of time and are awarded following application by a potential user. The General Director of Water (DGA) grants the water right provided that (a) the new water right does not impair existing rights and (b) the ecological requirement of minimum flow has not yet been reached by previous right allocations. Water use rights are granted free of charge and recorded in a national register; the granting authority reserves the right to restrict water consumption in times of water shortage.

Downstream owners of water rights have a right to a percentage share of the river flow but no protection against reductions of downstream flows due to increases in upstream use. While owners of consumptive rights (e.g., irrigation) have no specified obligation with regard to quality or quantity of return flows, owners of non-consumptive rights (e.g., hydropower and recreation) are required to return the same quantity and quality of water. The distribution of water according to existing property rights is organized by water users' associations under the control of DGA. The water users' associations are also responsible for maintaining the irrigation infrastructure.

Water rights are freely tradeable and the market for water rights is quite active. Seasonal water rentals are particularly frequent within the agricultural sector. Farmers also sell or lease water rights to water supply utilities who often find such purchases a significantly less costly source than the development of new sources of supply for urban and industrial use. Individual negotiations determine the price of each transaction.

The tradeable water rights system in Chile has both advantages and limitations. On the positive side, growing water scarcity is accommodated through demand management (conservation, improved efficiency, and higher prices) rather than through rationing or the expansion of the water supply with consequent environmental impacts. Water users receive a price signal indicating the true opportunity

cost of water and are thereby made to undertake conservation measures. Water flows from low-value to high-value use with a consequent significant reduction in over-irrigation, a major cause of waterlogging and salinization.

On the negative side, unregulated water markets may fail to internalize externalities such as minimum flow requirements, water quality changes, return flows, and watershed protection which requires integrated watershed/river basin management. To deal with these externalities, a number of proposals are being considered including: (a) charges for new water rights; (b) a five year limitation or an annual charge for unused water rights (varying according to regional water scarcities); (c) guarantee of an ecological minimum water flow by the DGA; and (d) the establishment of watershed management corporations to resolve intersectoral water use conflicts, water quality management, and watershed protection, all of which are expected to be self-financing through water charges.

Chile also applies the principles of marginal cost pricing and full-cost recovery (including a return to inverted capital) in the provision of water supply and sewage collection in urban areas. “The tariffs are based on the marginal cost of additional supply if new investments are necessary and on the marginal cost of the optimized, entire system, based on replacement costs if the existing capacity is sufficient for the foreseeable demand” (Hartje et.al., 1994). The tariffs are divided into fixed charges (for connection) and variable charges based on the volume of water consumed and wastewater collected. The full-cost recovery system is implemented gradually over a four year period and is expected to reach its full targeted level in 1994. Tariffs vary by region depending on the marginal costs of supply in each region: while in Santiago the tariff is US $0.32 per m^3 in the south it is twice as high and in the north, four times as high. To cushion the impact on low-income consumers and reduce the repressivity of tariff charges, the government has introduced a personal subsidy system targeted at about a quarter of the users (those with the lowest incomes) at a cost equal to about 2.5% of the total revenues of the water utilities.

Controlling Industrial Effluents: The Malaysian Effluent Charge System

As far back as 20 years ago, the **Malaysian** Environmental Quality Act of 1974 included provisions for using economic incentives and disincentives in the form of effluent charges in support, rather than replacement, of regulatory controls on discharges. The act requires that all dischargers pay a fee to obtain a license to discharge waste into public water bodies. Because the license fee varies with the level of waste discharged, it is effectively a discharge fee (Knesch, 1991). The fee varies according to one or more of the following factors: (a) the class of the premises; (b) the location of such premises; (c) the quantity of wastes discharged; (d) the pollutant or class of pollutants discharged; and (e) the existing level of pollution.

In 1977, the discharge fees provided by the Act were combined with discharge standards into an incentive-supported regulatory regime for controlling pollution from palm oil mills. The first discharge fees were collected in 1978. With the standards becoming more stringent over time and the discharge fees becoming larger with the quantity of waste discharged, the results were dramatic. Despite a 50% increase in the number of palm oil mills between 1978 and 1982 and a steady increase in palm oil production, the total biochemical oxygen demand (BOD) load released in public water bodies dropped steadily from 222 tons per day in 1978 to 58 tons in 1980, 19 tons in 1982, and 5 tons in 1984 (Ong et al., 1987, quoted in Knesch, 1991). According to Ong et al. (1987):

“The charging of high effluent-related fees as well as granting incentives by way of waiver of fees for research had the effect of expediting the pace of research, and notable successes have been achieved in palm oil mill effluent treatment technology. Malaysia can justly claim credit for having developed its own technology to treat palm oil waste and protect its environment.” (p.39)

The Malaysian combination of economic charges and standards worked as follows. In the first year (1978) of implementation of the system, the standard was set at 5000 mg/l of BOD and was not mandatory, in recognition of the initial difficulties that would be faced by the industry. The effluent related license fee was set at US $3 per ton of BOD discharged up to the standard. In the following year, the BOD standard was made stricter (2000 mg/l) and mandatory and progressive effluent charges were imposed to provide an incentive for the establishment of waste treatment facilities. If the BOD concentration exceeded the prescribed standard, a surcharge was imposed equal to $100 per ton above the standard. This is equivalent to a non-compliance fine or a compliance incentive. The rates were set such that the annual fees for untreated discharge exceeded at least the capital costs for building treatment facilities based on the anaerobic lagoon treatment facility. This already departs from the theoretically correct effluent charge which should equal the marginal environmental damage,

not the costs of installing a discharge treatment facility. Nevertheless, the system performed fairly well in managing pollution problems in the palm oil industry as long as the charges maintained their real value and were fully collected. By 1984, when the effluent standard was tightened to 100 mg/l, the BOD load discharge by the palm oil industry was down to only four tons per day out of 1640 tons of BOD generated per day. A similar system, apparently with equal success, was adopted for the control of pollution by the rubber industry. By 1984, most rubber factories were discharging BOD under 100 mg/l and the total BOD load discharged was down to five tons per day out of a total load of 200 tons generated per day.

The combined effluent, standard-charge system, however, was more effective than efficient. First, the charge was not set on the basis of marginal environmental damage costs, as the economic theory of externalities requires for optimal pollution control, but based on the cost of capital investment in treatment facilities with the apparent objective being the construction of waste treatment facilities rather than the control of pollution to optimal levels. This is also supported by the fact that the basic effluent charge is no longer enforced, but the surcharge for effluents above the standard is enforced.

A second problem with the Malaysian effluent standard-charge system, with regard to efficiency, is the imposition of the charge on BOD load rather than volume of discharge. This would clearly provide an incentive for some firms to dilute their effluent to avoid the charge, without actually reducing the total BOD load entering the river. Evidence for this is lacking but some developed countries, such as the Netherlands, base their effluent charges on a combination of effluent volume and BOD concentration that discourages dilution.

A third problem with the Malaysian system is the implicit incentive for intermedia substitution. While both a basic charge and a surcharge are also levied on discharges on land, the basis for the charge is volume, not concentration, while the basis for the surcharge is BOD load above the standard. While this is an effort to address the weakness with the BOD-only-based charge system for disposal in water bodies (identified above), it results in a higher discharge level for land disposal and encourages a shift of disposal from land to water. Again, the fee structure did not reflect marginal environmental damage from disposal in different media, but rather an attempt to offset the higher cost of waste treatment for charge into water courses.

Vincent (1993) analyzes in detail the economic efficiency (cost-effectiveness) of the Malaysian effluent standard and charge system, using an economic model of cost-minimizing abatement and disposal behavior by palm oil mills, and compares it with alternatives, such as command-and-control only (aggregate BOD standard allocated among mills according to output) and emissions trading among mills. While the results of this exercise are not yet available, it is clear that despite its effectiveness in controlling palm oil pollution, the Malaysian mixed regulation-incentive system was not economically efficient. Yet it was a pioneer system for a developing country, and despite its inefficiencies, it did not result in loss of competitiveness for the Malay palm oil industry. According to Rahim (1991), Malaysia's palm oil export sector "lost only 5% of the value of output as a result of environmental regulations from 1982-1986 that reduced allowable BOD discharges by 90%. The CPO [crude palm oil] sector lost even less—only about 1% of the value of production … despite the highly competitive nature of world oil markets (Vincent, 1993; p.24)." In contrast, Rahim found large losses among the primary input producers, the oil palm plantation sector, which bears over two-thirds of the total welfare losses of the industry.

The Malaysian combined effluent standard-charge system is still in effect but has apparently lost part of its original rationale (to promote waste treatment facilities) and its potency. With treatment facilities becoming a licensing requirement and standard feature of palm oil mills, the basic charge is no longer enforced. The surcharge for effluents above the standard is still enforced but it is so low (having lost much of its real value to inflation) that it no longer acts as a compliance incentive: some mills find it more advantageous to pay the surcharge rather than treat their effluent sufficiently to meet the standard.

In conclusion, despite its weaknesses—and to some extent because of them—the Malaysian mixed regulation-incentive system holds valuable lessons for developing countries that are contemplating the introduction of economic instruments in support of their environmental regulations. Neighboring Indonesia has recently been considering the introduction of economic incentives to increase compliance to its industrial environmental standards. The Malaysian experience should be helpful both in this general context as well as in the specific case of pollution from the palm oil industry. Sections of rivers in north Sumatra are reported to be anaerobic because of heavy BOD loads from palm oil mills (some of the them state owned) despite stringent discharge standards. An effluent

charge system with improvements drawn from the experience of Malaysia is certain to increase compliance of privately owned palm oil mills. As for state-owned firms, the Polish experience discussed below indicates that economic charges have little impact on the behavior of state enterprises because: (a) the profit motive does not operate to minimize costs; and (b) the soft budget constraint of such enterprises allows the shift of charge payments to the state budget. Under these circumstances, privatization may be necessary for economic charges to work.

Controlling Industrial Emissions: The Polish Pilot Project in Tradeable Emission Permits

A tradeable industrial emissions demonstration project was recently started in **Poland** (Dudek et. al., 1992). The project seeks to show that the economic instruments that have been successful in the U.S. also offer a significant potential for pollution abatement for economies in transition. These countries, which are heavily polluted but striving to attain sustainable growth, face economic and environmental investment costs in excess of annual GNP. If demonstration projects can provide evidence that economic instruments are both environmentally and economically effective, they may help to overcome the institutional, social, and political obstacles to the adoption of economic approaches to environmental management and the implementation of economic instruments.

The demonstration project, which began in March 1991 and was implemented in Chorzow, Poland in July 1991, is expected to involve at least six large enterprises and a number of small district heating plants. To date, two enterprises have participated: Steel Mill Kosciuszko (one of Poland's “Top 80” polluters) and The Power Plant Chorzow. These firms are heavy polluters and need new equipment before they will be able to comply with environmental regulations. Replacing the old equipment could take as long as six years. In the meantime, the current regulatory system offers no alternative to current extreme environmental damage and likely plant closure with the loss of municipal heating and electricity supply.

A tradeable emissions program is recommended, using a combination of bubble policy and a revolving fund. The regional administrator would issue an emissions permit for the power plant, which would use a combination of control technology and emissions reductions credits to achieve the ambient standard. The power plant would obtain these credits through financial support of the steel mill, which would reduce pollution by accelerating changes. The system would gradually improve the city's air quality without disrupting its municipal structure.

Because the region is extremely degraded, it was felt that some external support was needed. An external study (from regional environmental funds) was provided to the steel mill to facilitate restructuring. The subsidy is intended to initiate the revolving fund to benefit the participating polluters who reduce emissions.

The demonstration project has already shown some promise. Despite legal and social problems, educational efforts have achieved positive attitudes towards the experiment from potential participants. It is believed that there are also many opportunities for successful replication of the project, both in Poland and in other economies in transition. Hopefully, the success of demonstration projects will promote greater acceptance of economic approaches to environmental management.

Decongestion of Urban Settlements: Road Pricing in Singapore and Auctioning of Street User Rights for Urban Buses in Chile

Road transport imposes a variety of external costs on society not directly paid by the beneficiaries (that is, the road users): (a) wear and tear on the road infrastructure necessitating more frequent maintenance; (b) road congestion necessitating expansion and upgrading of the road system; (c) air emissions that are detrimental to health, property, and nature; (d) noise pollution and associated vibrations that affect sleep, mental health, quality of life, and property values; and (e) road accidents that damage vehicles, incur medical costs and loss of output as well as pain, grief, and suffering. Not all of these external costs are conventionally thought of as environmental costs, but virtually all have environmental implications. For example, road congestion increases air and noise pollution per kilometer traveled as well as necessitating road expansion that encroaches on nature and open space. Similarly, the increased frequency of road accidents not only lowers economic output and quality of life but also necessitates the expansion or modification of infrastructure that has environmental costs in addition to economic costs.

Like many cities, **Singapore** has suffered from the environmental effects of a growing car-driving population: congestion resulting in longer travel times for cars and public transport alike, air pollution, wear and tear on roads, and a lower quality of life for those living and working in heavily congested areas. Because car drivers do not naturally bear the substantial costs they impose on society, charging for urban road use is theoretically appealing. The success of Singapore's Area Licensing Scheme demonstrates its practical appeal as well.

In 1975, cars represented half of Singapore's 280,000 registered vehicles and were owned at a rate of one per 16 people. In an attempt to reduce central city traffic from 25% to 30% during peak hours, the city implemented a scheme that charged drivers for using roads in the city center during these hours. Specifically, the city aimed to: a) reduce car use within certain areas during particular times; b) leave economic activity unaffected; c) enact a scheme that was easy to implement and enforce; and d) provide those no longer driving into the inner city with attractive travel alternatives. The area pricing scheme required vehicles traveling through the city center at peak hours to purchase a daily or monthly license, raised daytime parking fees within this area, and instituted a park-and-ride service to facilitate easy non-car commuting. Buses, cycles, and cars with four or more passengers were exempted from the licensing requirements.

The scheme had the following effects. Above all, it achieved a traffic reduction of 73% in the restricted zone during peak hours. In addition, business seemed largely unaffected, and although the park-and-ride option was not heavily utilized the city found the overall scheme easy to implement and enforce. Carpools increased from 10% to 40% of all traffic. Thirteen per cent of car-owning commuters traveling into the zone switched to public transport, and about the same percentage changed their commuting time to pre-peak hours. For those who did not change their habits to avoid the zone during peak hours, the monthly average commuting cost rose from US $64 to US $95. More significantly, all but one-tenth of “through zone” commuters changed their route or departure time to avoid licensing fees. Travel speeds increased by 10% on incoming roads and by 20% on zone roads. There were additional environmental benefits. Although other pollutants were difficult to measure, the level of carbon monoxide declined significantly during the hours the scheme was in effect. Central city residents and shoppers reported greater ease and safety in getting around, less fumes, and generally happier living and shopping conditions.

Generally, all affected groups concurred that the impact on Singapore was positive, with motorists being the only ones to perceive themselves as worse off, though not badly so. Their perceptions were accurate since they were, in fact, shouldering more of the social costs of their car use. With an initial return on investment of 77% (which rose to 95% with an increase in license fees) the scheme achieved its goals without undue budgetary costs. Less quantifiable, but more significant may be the long-term benefits, specifically the road construction or future congestion that may be avoided due to changed habits and attitudes towards public transit and car use.

In another part of the world, Santiago, **Chile** suffered from a similar congestion and pollution problem in the late 1980s, as did Singapore in the mid-1970s, but for a different reason. Ten years earlier the Santiago urban public bus system was completely deregulated and made a free access system. This resulted in rapid expansion of the bus fleet to 13,000 buses, 40% above the optimum (rent-maximizing) level. Congestion resulted both from the excessive number of buses and the lack of coordination of bus stops. Transport-related emissions grew as a result of the large number of buses and taxis scouting the city streets for passengers, the very low speed, and the lack of minimum standards of quality. Despite the formation of an operators' organization, the “Consejo Superior del Transport,” which was able to raise prices, excess congestion continued because most buses were depreciated and continued to operate with low occupancy as long as they covered their operating costs (Hartje et. al., 1994).

To relieve congestion in the streets of central Santiago, a new law was passed in 1991 to enable the Ministry of Transportation to establish regulations regarding minimum quality of service, air pollution, and access to congested roads. A number of innovations were introduced under this law. First, buses and taxicabs older than 18 years were bought by the government for their scrap value and retired. By 1994, as much as one-third of the fleet was to be retired. Second, a registry for public transport vehicles was established, and entry was limited to new vehicles. Third, service quality and air emission standards were introduced. Fourth, the rights of access by buses and taxis to roads congested by these vehicles were auctioned. To ensure compliance and reduce enforcement costs, only incorporated companies were allowed to bid, thus providing a strong incentive for incorporation of small operations into companies or cooperatives. The selection criteria included quality of proposed

service, air emission characteristics, and frequency on specific lines to ensure that the reduction came from frequency reduction not from change in spatial structure of lines (Hartje et. al., 1994).

The system had a number of beneficial outcomes. Overcapacity was reduced by 30%, the occupancy rate of buses increased, congestion was relieved, and air pollution reduced at least proportionately (specific figures are not yet available). The reduced frequency of service and increased waiting time were offset by the increased speed of service. A negative side effect of the auction system has been the relocation of small operations to adjacent streets and residential areas, somewhat diluting the effectiveness of the auction (Figueroa, 1993). In response, the government is planning to extend the auction system to a wider area. There is also a proposal for a similar system for private cars, including a road pricing system.

Like the Singapore congestion pricing system, the Santiago auction system may not be applicable everywhere, but the innovative ideas it contains could help devise a system for cities, like Manila, with similar congestion and pollution problems and a large private fleet of public transport.

CHAPTER 6 ECONOMIC INSTRUMENTS FOR THE GLOBAL COMMONS

The scope and role of economic instruments are not limited to the management of domestic environmental problems, but extend to the management of the global commons, such as the conservation of tropical forests, the preservation of biodiversity, and the protection of the global climate and the ozone layer. As in the case of local environmental problems, the cost of controlling global pollutants or conserving resources of global significance varies significantly among countries as does people's willingness to pay for accomplishing global environmental objectives. The demand for global environmental policy comes mainly from the developed countries which have sufficiently high incomes and low discount rates to be concerned with environmental amenities and distant threats to their lifestyles. The lowest cost supply comes mainly from developing countries either by virtue of their greater biodiversity, lower energy efficiency, or lower opportunity costs. Under these circumstances equal or proportional emission reductions by all countries would be excessively costly, if not totally unacceptable to developing countries. Economic instruments could be used as vehicles for the internalization of global environmental benefits to developing countries: in terms of efficiency, the cost of a given global environmental improvement would be minimized (cost-effectiveness); in terms of distribution, the wealthy beneficiaries would pay and the poor countries would benefit (equity) along the lines of the “beneficiary pays principle.”

In the absence of a global government with taxation power, developed countries' willingness to pay for conservation could be captured through new innovative trading arrangements between developed and developing countries. Developing countries need financial resources and efficient technology to pursue sustainable development, in exchange they can offer:

a) unmatched biological diversity that can best be preserved only *in situ*;

b) forests that are of global significance in terms of their impact on global climate and atmospheric balance; and

c) environmental amenities that include wildlife and other natural assets of recreational, educational, and scientific value.

The South could offer to trade environmental conservation for financial and technological resources on behalf of the global community. It has a comparative advantage to do so because protection and maintenance of natural resources is labor-intensive and requires proximity and intimate knowledge of the resource, as well as interest in preserving national sovereignty.

But how are such trading arrangements actually to be effected? While there is a well-developed market for financial and technological resources, there is no such market for the conservation of natural and biological resources. This is due to the nature of these resources (global externalities), the lack of well defined (and fully recognized) property rights, and the difficulty of enforcing contracts across borders in the absence of a “global authority” that supersedes national sovereignty. Moreover, the object of conservation and exchange is difficult to define and monitor. Despite these difficulties, some exchanges of this nature have taken place. Examples include debt-for-nature swaps, the Global Environmental Facility, the prospecting rights purchased by the Merck Pharmaceutical Company in Costa Rica, and the EcoFund in Poland created through debt-conversion and several carbon-offset arrangements between northern power utilities and southern energy companies or forest concerns. However, as these exchanges circumvent rather than enhance the market, they remain more the

exception than the rule. Just as other goods and services are traded, mechanisms need to be developed through the market for trading conservation and global climate protection. Transferable development rights and internationally tradeable emission permits provide such mechanisms.

Conserving Biodiversity: Transferable Development Rights

Much of the conflict between developed and developing countries concerning the conservation of biodiversity arises from a failure to distinguish between ownership and the spatial exercise of development rights. The treatment of biodiversity as a global rather than national resource and the pressures to conserve it are perceived by developing countries as a challenge to their ownership and sovereignty over these resources. If, however, the primary purpose of efforts to protect biodiversity is conservation, not redistribution of resources, the first step is to recognize the ownership of developing countries over these resources and their right to develop them in order to maximize their own benefits. The only negotiable issue then is the terms by which the development rights over critical habitats would voluntarily be transferred elsewhere in the country or abroad.

The concept of transferable development rights (TDRs) makes possible the creation of conservation areas without the need for assessment of land values and compensation: it simply creates a market with the demand and supply of development rights that results in an equilibrium price at which exchange or transfer takes place.

In principle, there is no reason why TDRs cannot be used internationally to transfer development rights between countries. Tropical countries could set aside habitats for biodiversity conservation and divide each habitat into a number of TDRs, corresponding to an area unit, say, a hectare. Each TDR would state the location, condition, diversity, and degree of protection of the habitat and any special rights that it conveys to the buyer/holder. TDRs could then be offered for sale both locally and internationally at an initial offer price that covers fully the opportunity cost of the corresponding land unit (i.e., the net present value of the income stream of the foregone development opportunity). It is preferable to start at a relatively high price to test the market, since undervaluation is irreversible (following sale) while overvaluation is reversible (following non-sale). If the price turns out to be too low to clear the market (i.e., to exhaust the supplied TDRs for a particular habitat), the price could be lowered to attract additional demand or the quality of the TDR can be enhanced by enlarging the area to include additional biodiversity values or by improving its protection and management.

The potential buyers of TDRs include local and international environmental organizations, local and international foundations and corporations, developed country governments, chemical and pharmaceutical companies, scientific societies, universities and research institutions, and even environmentally minded individuals from the developed countries. The motivation for purchasing TDRs would naturally vary among prospective buyers. Some may have direct use values such as prospecting for new chemicals or pharmaceuticals. Others may be expressing their non-use values through the purchase of TDRs. Yet others might buy and hold TDRs if they expect them to rise in value as a result of decreasing supply and increasing demand due to population and income growth, change in tastes, or an increase in environmental awareness. Certainly every new discovery of a valuable new species, or even a new use of existing species found in a particular habitat, would increase the value of the TDRs of that site.

Despite the variety of increasing benefits that TDRs may confer on prospective buyers and holders, it is unlikely that there will be sufficient demand to preserve all the habitats that are worth conserving (e.g. based on contingent valuation of willingness to pay), for reasons ranging from myopia to free-riding. Given the public-good nature of biodiversity conservation, governments of developed countries (the main beneficiaries) could take action to stimulate the demand for TDRs (pump priming).

One way developed countries can stimulate the demand for TDRs is by providing credits to domestic firms and property owners for the acquisition of TDRs from developing countries against domestic environmental regulations such as building codes, forest harvesting and replanting regulations, environmental emission standards, CO_2 emissions, etc. A criticism of this method of stimulating the demands for TDRs might be that the conservation of biodiversity in the tropics would have been accomplished at the expense of the domestic environment in the developed countries. One way around this problem is to tighten environmental regulations from current levels and then provide offset credits for buyers and holders of TDRs. Another method is to introduce a conservation tax and then allow people the option to pay this annual tax or purchase and hold TDRs from conservation areas in lieu of the tax. The great advantage of this financing mechanism for the conservation of tropical forests and biodiversity is that it makes the opportunity costs clear and provides a vehicle for the

beneficiaries to pay them. It also provides developing countries with substantial transfers of financial resources for sustainable development without compromising national ownership or sovereignty over tropical forests. Not only can TDRs be bought back, they can be leased on an annual basis rather than sold outright. Essentially, what the country is selling or leasing are not the rights to exploiting or developing its forests, but conservation services.

Protecting the Global Climate: Internationally Tradeable Emission Permits

Virtually unlimited opportunities for low-cost reduction of greenhouse gas emissions are another grossly undervalued resource in potentially high demand in the North and for which the South has a comparative advantage to supply in exchange for financial and technological resources. While reductions of CO_2 emissions from fossil fuel consumption in Japan and the EEC might cost over US$100 per ton, in developing countries, such as India and China they would cost under US$10 per ton. If CO_2 emission reduction were a conventional commodity, there would be no doubt about where developed countries would seek to obtain these supplies from. Today two obstacles stand in the way of emissions reduction trading. First, there is no binding obligation on countries to contain their emissions. The Climate Convention could change that, especially if amended to set an aggregate ceiling on greenhouse gas emissions, allocated among countries according to population size or a combination of population size and some other variable such as GDP or historical level of emissions. Any allocation mechanism that has any chance of being accepted by the South would result in excess demand for emission permits by the developed countries and excess supply by the developing countries, setting the stage for emissions trading. Even if allowable emissions are frozen at historical levels, growth would generate demand for additional emission permits which could be more easily obtained from developing countries through improved energy efficiency rather than from developed countries such as Japan or Germany where further improvements in efficiency or reductions in emissions could only come at a high cost.

Allowing emissions trading across nations would obtain a given reduction of emission at the lowest possible cost and also encourage technology transfer and flow of financial resources from North to South in the interest of both the protection of global climate and sustainable development. For most developing countries, tradeable emission permits would be a major source of financial inflow and technology transfers and a strong incentive to become more efficient to save emission permits for sale to other countries or for their own industrial expansion.

Joint Implementation and Carbon Offsets

Joint implementation is a bilateral arrangement between developed and developing countries to collaborate on a global commons problem in recognition of the potential mutual benefits arising from differential opportunity sets (determined by differences in the level of development, technology, and preferences). A developing country with low-cost carbon emission reduction opportunities and in need of new technology and financial resources may cooperate with a developed country that has both the technology and the financial resources but needs low-cost carbon emission reductions (or sequestration) opportunities to meet its obligations under the Global Climate Convention. The cooperation, or rather, joint implementation may take the form of the developed country transferring help to the developing country in terms of financial resources and technology—helping them to become more energy efficient by switching fuels (e.g. coal to natural gas) and protective of their forests (planting trees in degraded watersheds)—-in exchange for carbon reduction credits against the country's international obligations. These exchanges or carbon offsets, as they are known, could take place between the two countries' governments or private sectors (with government endorsement).

One such type of carbon offset is between a developed country utility and a developing country forest company or forest department. The power utility finances a shift to reduced impact logging techniques, enrichment planting (or reforestation), or forest conservation in a developing country in exchange for credit for the carbon saved or sequestered by the funded forestry activity. The potential benefits are substantial (arising from differential costs of CO_2 reductions between developed and developing countries) and shared between the parties involved (both private and public). While several such pilot offsets have been initiated in recent years (e.g., New England Electrical System with the Sabah Foundation and Applied Energy Systems of Virginia with Guatemala), North-South carbon offsets have not yet been sanctioned by governments or the global community as a legitimate means of meeting CO_2 reduction obligations under the Climate Convention. Despite criticism of this

and other joint implementation mechanisms, there is sufficient interest by both the North and South to warrant further study and experimentation. Carbon offsets is one mechanism by which the global value of carbon sequestions can be internalized by the local populations of developing countries. Joint implementation, if properly designed and implemented to be efficient and equitable, is indeed an application of the cost-effectiveness and beneficiary pays principles of efficiency and equity, respectively.

CHAPTER 7 THE SPECIAL CIRCUMSTANCES OF DEVELOPING COUNTRIES AND THE APPLICABILITY OF ECONOMIC INSTRUMENTS

Despite the increasing use of economic instruments by developing countries, their applicability to developing country conditions continues to be questioned by environmental groups, development assistance agencies and developing countries themselves. Indeed, much of the technical assistance received by developing countries is skewed towards the use of command and control regulations. The conventional wisdom that economic instruments are of limited applicability to developing countries is based on the argument that their circumstances are radically different from those of developed countries and therefore developed country experience is of limited relevance. The increasing use of economic instruments by developing countries is often dismissed as experimentation by middle-income, newly industrialized economies that is of little relevance to low-income agrarian economies. The objectives of this chapter are to examine the special circumstances of developing countries that might affect the applicability of economic instruments, either positively or negatively, and to assess the applicability of particular instruments to particular circumstances, especially those of low-income countries.

By definition, developing countries differ from developed countries by their level or stage of development, as measured by income per capita. This definition of development is by itself unsatisfactory for inter-country comparison, even in the narrow economic sense. Converting income per capita into purchasing power parity alters significantly the “development” ranking of countries. Further adjustments need to be made for differences in quality of life indicators such as child mortality, life expectancy, literacy, etc., which are not always correlated with income. These adjustments result in further changes in the “development” ranking of countries (see for example UNDP's Human Development Index). Even then, resource depletion and environmental degradation are not accounted for and hence the “development ranking,” even after the purchasing power and quality of life adjustments, is biased against countries that practice resource conservation and environmental protection.

With these caveats in mind, but without a more widely accepted and understood alternative, we use the conventional definition of developing countries as the non-OECD countries, excluding the transitional economies of Eastern Europe and the former Soviet Union and the high-income oil-exporting countries such as Brunei, Kuwait, Saudi Arabia, and the Gulf States. This definition still leaves more than 120 countries ranging from the tiny Pacific Islands to China. The ecological, cultural, and political diversity is at least as wide as the differences in size and geography. Therefore, the special circumstances describe below are generalizations that apply more to some countries than others, but do constitute distinguishing features of developing countries as a group, from the OECD countries taken also as a group. However, since developing countries are far from a homogeneous group, a further classification into low- and middle-income countries is appropriate. The latter group is defined to include the newly industrializing economies. Correspondingly, the special features of developing countries discussed below apply *par excellence* to low-income countries and to a lesser degree, to middle-income countries.

Development Priorities Growth and Distribution

Economic development and poverty alleviation are the top priorities of developing countries, while maintenance of prosperity and of quality of life, through economic stability and environmental protection, is the primary concern of developed countries. A 2% to 3% growth rate, considered an accomplishment among OECD countries, is lamented as a failure among developing economies, which, given 2% to 3% population growth must grow at least that fast to stand still at what is a very unsatisfactory standard of living. Growth rates of 5% to 10% are aspired to by all developing countries but achieved by only a few. Yet high growth rates remain a priority even for those developing countries that are experiencing stagnation or even economic decline (e.g., sub-Saharan Africa), perhaps more so; hence they are unlikely to give high priority to environmental protection unless it is

seen as an effective means of escaping stagnation and of achieving high rates of economic growth. This has significant implications for the applicability of economic instruments in general and for the right choice of instruments in particular. First, instruments with applications to natural resource management are of special interest to low-income resource-based economies while instruments of industrial pollution control are of particular interest to newly industrializing countries. Second, the effect of the instrument on economic growth is of primary concern. Instruments that restrict or constrain economic growth conflict with developing country priorities. The instrument must achieve its purpose at the lowest cost possible, and whatever that cost is, it must not be such as to adversely affect the competitiveness of the country's exports as a whole, even if particular exports might be affected.

More positively, the instrument must help improve the efficiency of resource use, increase productivity, and economize on scarce resources (e.g., capital, skills, and management). It is also desirable that the instrument promotes the search, development and adoption of more efficient, less wasteful production technologies. Clearly, the development priority of developing countries favors the efficiency, cost-effectiveness, and flexibility of economic instruments over the rigidity and cost-insensitivity of command and control. Moreover, it has clear implications for the choice of economic instruments and the mode and speed of their introduction. Clearly, secure property rights, efficient taxation of natural resources, and gradually phased-in pollution charges are favored by the high priority that developing countries attach to their growth objectives.

At the same time, poverty alleviation and improved income distribution are also among the top objectives of developing country governments. Therefore, the distributional implication of economic instruments is also of primary concern. It is not sufficient that secure property rights to open access resources are assigned; it matters who gets them. If the poor who depend on these resources for survival are assigned the property rights, both efficiency and distribution improve, otherwise efficiency is gained at the expense of equity. Similarly, the incidence of pollution or product charges may by regressive if they raise the price of goods that account for a higher percentage of poor people's expenditure, or if the environmental improvement so attained benefits mainly the rich. Distributional concerns may disqualify certain instruments (e.g., bidding for open access resources), favor differential rate structure (e.g., lower charge rates for basic necessities), or suggest mitigation measures (e.g., offsetting the regressivity of tax charge incidence by the progressivity of spending charge revenues). Of course, the ultimate choice of the appropriate instruments would also be influenced by other features of developing countries, to which we now turn.

Low Willingness to Pay for Environmental Amenities

The lower per capita incomes of developing countries imply higher marginal utility of income and lower willingness to pay for environmental improvements and amenities. Whenever a development opportunity and environmental protection are in conflict (or in a tradeoff relationship), the choice between the two would be influenced by existing levels of income, as well as by other factors such as preferences, environmental awareness, etc. Other things constant, low income people would assign a relatively higher value to each additional dollar of income (from the development opportunity) than rich people, because of the higher marginal utility of income at low-income levels. At the same time, poor people have a lower willingness to pay for environmental quality or amenities because environmental services are income elastic (i.e., their demand is low at low income levels but rises more than proportionately with income growth). Both these factors would result in individuals assigning higher priority to development than environmental protection (unless of course, the latter is an input into the former).

Thus, economic instruments set according to estimates of marginal damages or marginal benefits derived from estimates of people's willingness to pay for a benefit (or accept compensation for a damage) better accommodate the significant differences in willingness to pay and marginal valuations of income between developed and developing countries than do command and control regulations. This is particularly important at low levels of income, where survival can be threatened by a small change in prices or a reduction in income. Therefore, the developed country regulations and standards (or level of pollution charges) are not suitable for poor countries and if enforced, can in fact lower welfare and even threaten survival. Developed country *environmental* standards (not consumption patterns) can only serve as long-term targets or aspirations, just as developed country *living* standards can.

The above argument in no way justifies the transfer of polluting industries or the shipment of hazardous waste from developed to developing countries. In the case of direct foreign investment, environmental standards or charges are a relatively minor factor by comparison to access to new markets and to low-cost labor and material. Moreover, the environmental standards of developed countries are embodied in the capital and technology of the industry that moves to a developing country. Furthermore, the liability laws of the country of origin may apply and exported products must reflect the environmental standards of the trading partners. Shipment of hazardous waste is not justified because of the asymmetry of information regarding its true nature and potential risks between the shipper and receiver and because the receiver (developing country) lacks the knowledge and technology to treat and dispose of the waste safely. Furthermore, because of the low or zero assimilative capacity of the environment for hazardous waste, and the risk of leakage, spill, or dumping during transport, hazardous and toxic waste is best handled at its place of origin. In light of the uncertainty and asymmetry of information, treatment and disposal at the source are required for full internalization of the externality and application of the polluter pays principle.

Limited Tax Revenues

Tax revenues in developing countries are usually severely constrained by a narrow tax base, low incomes, and limited tax collecting capacity. As a result of limited revenues and major infrastructural expenditures, developing countries tend to run sizable budget deficits. Hence, they can ill afford the costs of a large environmental bureaucracy. As a result, their monitoring and enforcement budgets are very limited and their infrastructure for collection treatment and disposal of waste grossly inadequate. At the same time, they face severe administrative and human resource constraints. Given these constraints, the opportunity cost of resources necessary to implement, monitor, and enforce end-of-the-pipe command and control regulations are significantly higher than those in developed countries. The limited experience with administrative regulations and the inadequate information available for setting standards may lead to overly ambitious or unenforceable regulations. In contrast, economic instruments, if properly selected, can have low enforcement costs and generate significant government revenues. In contrast to command and control regulations, which often lead to increases in a developing country's already excessive dependence on narrowly-based, highly distortionary taxes, economic instruments are corrective taxes that can lower this dependence by serving as alternative sources of revenue.

The choice of specific economic instruments is significant in light of developing countries limited administrative and enforcement capability. For example, product taxes that use existing administrative structures may be preferable to emission charges or tradeable permits that require new collection mechanisms or additional administrative arrangements. Since product taxes are indirect instruments, they are not as efficient as pollution taxes, which directly attack the externality, the right instrument is determined by the balancing of the administrative cost savings against the efficiency losses. Low-income countries may thus opt for product taxes while middle income countries may choose pollution charges or tradeable permits on account of greater administrative and charge collection capacity. Refundable deposits and performance bonds are also easily administered instruments, but may not be equally suited to the resource endowment of poor countries. The collection and return of residuals and waste is usually a labor-intensive activity, well-suited to the labor-surplus conditions of many poor countries, while the posting of a bond requires substantial capital which is usually scarce and costly in developing countries but more easily available and less costly in middle-income and newly industrializing economies.

Legal, Institutional, and Cultural Constraints

Where legal institutions are weak or not well developed, as is the case in many developing countries, instruments that rely on legal action for enforcement are unlikely to be effective. Examples include command and control regulations such as effluent standards or mandated technology that provides for fines, prosecution, closure, and imprisonment in case of non-compliance. Another class of instruments difficult to enforce under these circumstances is legal liability systems, used extensively in the United States. Moreover, because of a long backlog of cases in the courts of most countries, the threat of court action does not act as a deterrent or compliance incentive.

In addition to the weakness of the legal system, many cultures are not given to litigation in the same way that Western culture is. Courts are used as a last resort, which means they are rarely used. Since this is common knowledge, regulations that depend on court action are not complied with. Fines are

set at levels that are too low to deter violators given also the low probability of apprehension and conviction. Regulations that are replicas of developed country regulations have little grounding in local realities and culture and are therefore largely unenforceable. In cultures where the institution of private property rights is not sanctioned and contracts are not enforced by courts, (e.g., parts of sub-Saharan Africa), economic instruments that are based on private property rights or market creation are likely to fail. In these cases, the recognition and protection of customary, communal, or tribal rights are preferable to their supplantation by alien institutions of private and state property. Papua New Guinea provides an example of sensitivity and accommodation to institutional weaknesses and cultural traditions and realities. Indeed, traditional societies, while having weak legal systems and undeveloped modern institutions, often have time-tested traditional institutions, management systems, and customary use rights that can be strengthened or used as models for the development of new institutions and instruments that fit the local cultures and traditions as well as emerging new realities (e.g., commercialization, new technology, population growth, etc.).

Undeveloped Capital Markets and High Discount Rates

Natural resource conservation and environmental protection are analogous to investment, in the sense that they involve high current costs in return for a stream of future benefits of higher present value. This creates a cash flow problem, especially for societies with limited cash incomes. This problem can be solved through current borrowing and future repayment, a solution that presupposes well-functioning capital markets. In many developing countries, capital markets are segmented or distorted through interest rate ceilings, credit rationing, and capital subsidies, etc. Credit is generally very costly for small borrowers and often unavailable to those with no secure property rights for collateral. Furthermore, low incomes, often barely above survival levels, economic uncertainty, and political instability result in very high private discount rates applied to future benefits.

The implications of capital scarcity and high discount rates for the selection of instruments are that the right instrument does not impose a high initial capital cost. Therefore, mandated technology such as water treatment plants and economic instruments, such as environmental performance bonds or auctioning of pollution permits, are not suitable for countries with undeveloped capital markets and high rates of discount.[3] Where initial capital costs are unavoidable, as in the case of water or energy supply, instruments that aim at full cost pricing must accommodate the capital constraint by amortizing the capital costs into monthly payments integrated with the variable costs (user charges). In the case of natural resources, especially land, assignment of secure property rights is usually an effective mechanism for improving access to capital markets and for lowering the private discount rate for poor farmers. Removal of interest rate ceilings and capital subsidies (investment incentives) for large-scale industries increases the availability and reduces the cost of rural credit, further encouraging long-term investments such as soil conservation and tree planting.

Formative Stages of Development

In developed countries, the selection of instruments for environmental management is often constrained by the legacy of existing regulations, an entrenched environmental bureaucracy, and vested interests created by past and present policies and structures. Furthermore, with mature industries and cities and virtually all infrastructure in place, it is technically difficult and economically costly to introduce radical policy changes or new instruments. Retrofitting industrial plants and urban infrastructure, put in place under a different policy regime, are often very disruptive and costly, necessitating a very slow and gradual process of adjustment with grandfathering of existing industries.

Developing countries, being in the formative stages of their development, have considerably more flexibility than developed countries to introduce new policies and instruments of environmental management. First, without a large environmental bureaucracy and the vested interest created by past regulations, developing countries have an almost clean slate to introduce new instruments that best fit their own circumstances. Second, the limited fixed plant and infrastructure in place, the higher rates of investment and economic growth and the rapid turnover of capital stock imply lower implementation and compliance costs for new instruments as well as greater effectiveness, provided

[3] This conclusion does not preclude the use of these economic instruments for large-scale producers, both domestic and foreign.

that they are expected to remain in place and escalate over time to fully internalize environmental costs.

Economic instruments have the advantage that they can influence the direction and pattern of development of human settlements and industries without unduly constraining the pace of development. The rapidity with which urban and industrial centers are growing in developing countries provides economic instruments with the opportunity to achieve cost-effective environmental improvements through structural change, an opportunity that flees with every new investment planned and implemented under existing policies.

A related characteristic of developing countries is the large number of scattered, small-scale industries which are difficult to either regulate or tax. Product taxes, refundable deposits, and incentives for waste delivery are clearly preferable to effluent standards and charges or to market creation instruments which are costly to monitor and enforce when a large number of small and scattered polluters are involved.[4] Rapidly growing vehicular pollution and traffic congestion, as a result of increasing car ownership, are other characteristics of developing countries that the selected instruments must address cost effectively. Car ownership taxes, differential fuel taxes, and road tolls are among such instruments, provided that alternative means of transport (e.g., mass transit systems) are available.

Conclusion

Economic instruments as a group are at least as applicable to developing countries as they are to developed countries. The earlier, formative stages of development in which developing countries find themselves make the introduction of new, flexible instruments both easier and more beneficial. However, underdeveloped and inefficient markets and institutional and administrative constraints call for careful selection of specific economic instruments that fit (or are adapted to fit) the country's special circumstances. In addition to the stage of development and associated constraints and opportunities, the country's cultural traditions and social organization are critical factors to consider and build on in selecting and introducing incentive-based instruments for environmental management and sustainable development.

Transitional economies, that is, formerly planned economies which are now in the process of market reforms and industrial restructuring, temporarily experience some of the characteristics of developing countries (low incomes, limited tax revenues, priority for recovery and growth), but in other aspects (levels of industrialization, education, etc.) they also share features common with developed Western European countries. [This is less true of Central Asian Republics which share the conditions of developing countries]. Transitional economies (such as Poland and Russia) have historically used economic instruments for pollution control (pollution charges), but their effectiveness as incentives were minimal because of the lack of enterprise autonomy and the existence of the soft budget constraints (charges were paid and included in production costs to be covered by state subsidies). However, the familiarity of transitional economies with economic instruments and their bitter experience with command and controls in the economic sectors help them resist misguided Western advice to replicate Western command and control regulations. Many of these countries aspiring to join the European Community (EC) are in the process of adopting EC environmental standards, but appropriately aim to attain them gradually (through pre-announced compliance schedules and with the use of economic instruments).

CHAPTER 8 MODALITIES FOR THE INTRODUCTION OF ECONOMIC INSTRUMENTS

The selection of the relevant set of economic instruments for a particular developing country or a transitional economy at a given point in time is determined by the country's special conditions as discussed in the previous chapter. Yet this leaves a large set of instruments from which to choose. Criteria for specific instrument selection needs to be established, or if a set of instruments is selected, an assessment must proceed implementation. Furthermore, the adoption of an economic instrument approach to environmental policy and sustainable development and the specific instruments chosen

[4] This conclusion does not preclude the use of tradeable pollution permits to abate non-point pollution, as long as there are a few large polluters that share the same watershed or airshed.

would have institutional and human resource requirements and financial implications that need to be addressed. For example, certain instruments such as secure land titles require cadastral surveys; environmental bonds and self-assessed charges require environmental auditors; and revolving funds may require new institutions. The objective of this chapter is to detail the criteria for instrument valuation and selection and to assess the human, institutional, and financial requirements. Particular attention is paid to distributional considerations, dynamic efficiency, and political acceptability.

Assessment of Instruments

The assessment and selection of instruments is best done by asking and answering the following nine questions, all conditioned by the special circumstances of the particular country concerned:

Environmental Effectiveness: *Will the instrument achieve the environmental objective within the specified time span and what degree of certainty can be expected?* If the environmental outcome is somewhat uncertain or experimental (trial and error) and different instrument levels are needed, how acceptable is deviation from the set goal? The answer depends to a large extent on the nature of environmental damage in question. The acceptable margin of error is much higher for reversible environmental damage, depletion of substitutable resources, or generation of biodegradable waste than for irreversible loss of unsubstitutable assets (e.g., biodiversity, species loss) and generation of hazardous waste.

Cost Effectiveness: *Will the instrument achieve the environmental objective (or target) at the minimum possible cost to society?* Not only are environmental budgets limited, but any savings can be used to achieve other social objectives (e.g., equity) or to pursue further environmental improvement. The costs to society of pursuing certain environmental objectives through a particular instrument or set of instruments is not limited to the cost of monitoring and enforcement by the environmental agency. The largest component of the social cost of environmental intervention is the cost of compliance by the industry (e.g., output reduction, capital and operating cost of abatement technology, and the additional cost of switching to higher-cost inputs, such as from coal to natural gas). A second component of the social cost is the distortionary effect of the particular instrument chosen. Most economic instruments if rightly chosen and set at the right level (e.g., Peguvian taxes set equal to the marginal damage cost) are corrective of existing distortions and hence have a negative distortion cost (i.e., a correction benefit). There are, however, economic instruments such as subsidies which, though statically equivalent to environmental taxes, dynamically (in the long-run) they encourage entry into the polluting industry, thereby increasing rather than reducing pollution and hence violating the environmental effectiveness criterion above.

Flexibility: *Is the instrument flexible enough to adjust to changes in technology, the resource scarcity, and market conditions?* For example, in the face of inflation will it maintain its potency or will it be gradually eroded into an ineffective instrument. Indexing to inflation is one way of maintaining the value of the instrument; another is by setting the instrument (e.g., a charge in terms of a percentage of the price, rather than at a fixed nominal monetary value). With regard to scarcity, the instrument's value or level must rise with increasing resource or environmental scarcity. For example, tradeable emission permits meet this criterion, as do property rights (their value rises with scarcity); command and control standards and environmental bonds do not adjust automatically to changing resource scarcities (they need to be deliberately adjusted). With regard to technology, will the instrument adjust to changes in monitoring, abatement and production technology or will it soon become obsolete by new technologies? For example, mandated best available technology, an extensively used command and control instrument, does not meet this criterion unless it is deliberately and regularly revised, at great cost.

Dynamic Efficiency: *Does the instrument provide incentives for developing and adopting new environmentally cleaner and economically more efficient technologies? Does it promote development of an environmentally sound infrastructure and economic structure in general?* Charges and tradeable permits, for example, meet this criterion while effluent standards or mandated technology do not. Perhaps more importantly for developing countries is the extent to which the instrument provides an incentive for environmentally sound and economically efficient structural change. A dynamically efficient instrument is one that encourages the flow of resources towards activities in which the country has a genuine comparative advantage (i.e., towards commodities that can be produced at a domestic resource cost, inclusive of the resource depletion cost and environmental cost, which is lower than the world price). The structural-change effects of the instrument are equally important with regard to infrastructure and urban development. For example, low gasoline prices in the United States

have resulted in a dispersed pattern of development and land use that make the development of most transit systems unprofitable and the economy dependent on private driving, with the ultimate consequence being that air quality standards are very costly and difficult to accomplish. In contrast, European cities' mass transit systems are profitable because of the high density land use induced by high gasoline prices.

Equity: *Will the costs and benefits of the instrument be equitably distributed? Who gains and who loses?* This is a complex question but of critical importance to the successful introduction of economic instruments. Different instruments have different distributional implications. Environmental taxes tend to be regressive compared to regulatory standards. The pollution control costs fall more heavily on low-income groups, especially with product taxes or pollution charges that affect the prices of commodities (such as food, clothes, or shelter) on which the poor spend a higher proportion of their income. The benefits of environmental improvements such as improved water supply, sanitation, and reduction of indoor pollution of suspended particle matter (SPM) and of lead emissions, tend to be progressive (pro-poor) because the poor are more exposed to these pollutants due to their living and working conditions and the lack of means for preventive or mitigating expenditures. On the other hand, when these benefits are valued in monetary terms, their distribution may in fact be regressive because the poor have a much lower willingness to pay for environmental improvements due to their low income. Thus, ultimately the distributional impact of economic instruments depends on (a) how the property rights or pollution permits are allocated and (b) how the revenues from environmental taxes and charges are spent.

Property rights and trading programs (pollution permits, development quotas, catch quotas, etc.) can lead to large transfers of wealth between socio-economic groups and locations. As such, they can also act as instruments of social policy or income transfers to improve income distribution. For instance, the poor could be issued secure property rights over open access resources (e.g., land rights, water rights, etc.). The regressivity of environmental taxes can be dealt with through differential taxation (lower taxes on necessities). In principle, even tradeable pollution permits can be allocated in a way that benefits the poor (see Chapter 3). In controlling global climate change, internationally tradeable CO_2 emission permits are emerging as a major source for transferring financial and technological resources from North to South. The distributional impacts of different instruments vary by location and time horizon; they are higher in targeted areas (e.g., industrial towns, coal producing areas, etc.) and during the transitional period than in other areas and subsequent periods, respectively. Retraining, compensation for impacts, gradual implementation, grandfathering of old (or small) producers, and revenue neutrality (commensurate reduction of other taxes) are some ways in which the distributional impact of economic instruments can be mitigated or compensated for.

Ease of Introduction: *Is the instrument consistent with the country's legislative framework?* If new legislation is necessary, how feasible is it? Does the executive branch of government have the administrative capacity to issue the necessary regulations and administer the instruments? What is the administrative opportunity cost given the limited administrative resources in a poor country? This criterion favors instruments that do not require new legislation and which can be administered with existing administrative structures. For example, in countries with very scarce administrative resources, product taxes which use the existing tax collection system are preferable to pollution charges or tradeable pollution permits which require new legislation and new institutions.

Ease of Monitoring and Enforcement: *How difficult or costly will monitoring and enforcement be?* This is partly a function of the administrative capacity (discussed above and below) and partly a function of the structure of the industry towards which the instrument aims. Large numbers of scattered, small-scale economic units imply high monitoring and enforcement costs. A country with limited monitoring and enforcement capability will opt for indirect instruments (product taxes over effluent charges) that are embodied in the prices of inputs and outputs, or other self-enforced instruments such as bonds and deposit-refund systems which shift the burden (and the cost) of monitoring and enforcement to the polluters. Community resource management and customary use rights have the great advantage that the monitoring and enforcement costs are decentralized and internalized to communities which enforce them using their own internal organization, kinship relationships, and social norms. In terms of the introduction of new instruments, the challenge is to design them so they are self-enforced by drawing lessons from traditional systems. For example, the pollution charge imposed on an individual firm could be made a function of both the firm's own emissions and of the industry's total emissions, or of the airshed's or watershed's ambient quality, thereby providing incentives for the industry to police itself.

Predictability: *Does the instrument combine flexibility and predictability?* Flexibility is critical for cost minimization, adjustment to varying conditions, locations, and changing circumstances, and for gradual implementation. Predictability is critical for dynamic efficiency both in terms of technological innovation and structural change. The effectiveness of any instrument depends critically on the perception of its permanency and direction of change. Only when the industry perceives that a standard, a tax or a charge is in place to stay (that its value will escalate over time towards full-cost pricing rather than be eroded by inflation) will it modify its long-term investment plans to reduce environmental costs. It is the instability and unpredictability of environmental policy rather than the costs of compliance that the industry finds disruptive and ultimately more costly. Therefore, when an instrument is introduced gradually, the compliance or escalation schedule must be pre-announced and adhered to.

Acceptability: *Is the instrument understandable to the public, acceptable to the industry, and politically saleable?* This is perhaps the most difficult criterion to meet and definitely one which puts economic instruments in a disadvantageous position. Unlike the hidden costs of command and control regulations, the costs of economic instruments such as product taxes, pollution charges, user fees, environmental bonds, and liability systems, are all too transparent. Taxes are generally unpopular and user charges are unwelcomed when the service is taken for granted or if it has been available at a subsidized cost for a long time. Underpricing and subsidies become capitalized into property values and their removal is seen as a net reduction in the owner's wealth. Market creation, such as tradeable pollution permits, is often resisted by environmental groups and the general public as a license to pollute. Polluters would resist economic instruments such as taxes and charges if they perceive unenforced command and control standards as a feasible alternative, if they see an easier opportunity for regulators' capture in non-economic instrument approaches to environmental management such as the process of negotiation between polluters and regulators practiced in England. Exploiters of open access resources would generally resist regulations or closure of the commons from fear that they might be the ones that are excluded. Finally, the public is likely to be receptive to charges that economic instruments for environmental management are just another form of taxation or license for big polluters to continue to pollute. They are also likely to be receptive to calls for “environmental justice” in the form of either equal pollution reduction (in absolute or percentage terms) by all sources or uniform emission standards.

Therefore, the promoters of economic instruments have a hard sell and a difficult marketing task. Without making it clear to the industry, to environmental groups, and the public, the benefits and costs of the available options (including that of no action), the chances of acceptance and successful implementation are severely limited. Selecting simple and easily understood instruments makes the marketing task easier and the likelihood of acceptance greater. In addition, a number of mitigatory and compensatory measures can be introduced to lessen both the transitional and long-term cost. One such measure is revenue neutrality (i.e., reduction of other taxes such as income taxes which reduce the incentive for work or sales taxes and import tariffs that distort consumption decisions). Other mitigation measures include gradual implementation and grandfathering of existing producers. The support of environmental groups and the industry can often be secured through greater communication and participation in the selection and implementation of economic instruments.

Institutional and Human Resource Requirements

Economic instruments as a group tend to have lower institutional and human resource requirements than command and control regulations, because they operate through incentives rather than through coercion. First, it is far easier to implement an instrument that makes compliance in the best interest of the economic agent than an instrument which forces compliance through enforcement. Second, economic instruments make maximum use of the superior and privileged information that the polluters and resource users have on their own pollution control and resource conservation cost without attempting to find out what that information is. This contrasts with the considerable informational demands of command and control regulations which include intimate knowledge by the regulators of the production and pollution control technologies of a multitude of production processes. The informational parsimony of economic or market-based instruments can be compared to the informational advantage of market economies over those of centrally planned economies.

Nevertheless, the informational requirements of economic instruments are not insignificant, especially when one attempts to introduce them at the optimal level (i.e., at the point where the marginal control cost equals the marginal damage cost). This presumes knowledge of pollution control (or conservation), cost function, and environmental damage functions, none of which are readily

available. These informational requirements are considerably reduced if we only seek to attain cost-effectiveness (i.e., the environmental objective is set through some other means such as the political process or at scientifically-established ecological thresholds), and if the economic instrument only attempts to achieve this objective at minimum cost. Then experimentation with pilot projects or trial and error would help reveal the needed information for determining the optimal level of the instrument. Since gradual introduction is often preferable, the instrument can first be introduced at a very low level and progressively escalated, gaining information in the process until the optimal level is approximated.

The informational requirements can be reduced further by taking into account the special conditions of the country (see previous chapter), the industry, the environmental media, and the specific pollutant or resource whose control is sought (see next chapter). When the instrument is tailor-made to fit these conditions, the informational and enforcement costs are minimized. An ill-designed economic instrument or one which is alien to the culture of the country and the structure of the industry could have higher informational and enforcement requirements than well-designed command and control regulations. For example, effluent charges applied to scattered, small-scale industries in developing countries with a larger underground economy have enormous information requirements and little chance of successful implementation. Under these circumstances product taxes and deposit-refund systems, though indirect instruments, are overall more efficient.

While every effort should be made to choose instruments, designs, and modes of introduction that minimize the informational and management/enforcement requirements, there is an irreducible minimum level that must be met if environmental policy is to produce results on the ground. Informational and management requirements are translated into institutional and human resource requirements—two resources in high demand and limited supply in developing countries. To minimize institutional demands, maximum use must be made of existing administrative structures (e.g., existing tax collection, bureaucracy, industry licensing procedures, vehicle registration system, the town and country planning department, the government tourist agency, line ministries or departments such as forestry, mining, industry, and agriculture). For example, product taxes can be integrated with existing sales, excise tariffs, or Value Added Tax systems and collected by the relevant collection agencies. Betterment charges can be integrated with the property taxes and collected by the existing property tax department. Wastewater treatment charges or watershed protection charges can be incorporated into the monthly water bill and collected concurrently. Transferable development rights or land-use taxes can be implemented through the land registration department to maximize use of the private land market institutions (e.g., real estate firms, land surveyors, property value assessors, etc.)

Using existing institutions would significantly reduce the need for new institutions and additional human resources though it will not eliminate it entirely. For example, water rights, tradeable catch quotas, or emission permits would require a special registry which is regularly updated. Issuance of secure land titles require cadastral surveys and a process for the resolution of conflicting claims, while land use taxes call for land use registry. Performance bonds require a financial institution that will manage and reinvest the funds, pay interest, assess performance, and dispose the bond accordingly. Effluent charges require a monitoring and collection system which has relatively high institutional and human resource requirements because it calls for specialized knowledge and measurement capabilities. While existing institutions can be restructured or upgraded to handle many of these tasks, additional specialized organizational and human resources need to be added.

Among the new skills required are specialists in environmental impact assessment and valuation (damage or betterment assessment), environmental auditors and inspectors, environmental engineers and economists, financial analysts, environmental tax experts, etc. While some of these skills may not be available in developing countries, related skills exist and can be easily retro-fitted for the use of economic instruments in environmental management. External training and technical assistance might be needed for some time in certain countries but local expertise would not take long to respond if effective demand exists because related skills are often available.

What about legal institutions, legislation, and regulations needed to back economic instruments? Property rights, and enforcement of contracts are essential for the efficient operation of markets, on which the effectiveness of economic instruments, also known as market-based instruments, depends. As we have seen, where property rights cannot be defined in physical space, they can be defined in legal space (e.g., permits, licenses, quotas) which assigns right of use. Economic instruments require enabling legislation, legitimation, or legal frameworks, not detailed regulation. Environmental charges need to be legislated, unless they qualify as taxes or user charges permissible by executive decision within existing legal frameworks. Similarly, performance bonds and transferable development rights

need to be legislated and environmental funds need to be legally constituted. However, once economic instruments are in place they should be more or less self-enforced; otherwise, they have not been properly designed. The economic instruments approach to environmental management and sustainable development requires regulations to set the rules of the game not to specify and arbitrate every move. In most real world situations, a command and control structure already exists and economic instruments should not seek to replace it overnight, but support it, make it more flexible and cost effective by making allowances for differences in compliance cost through credit, offsets, trades, and other mutually beneficial exchanges.

Financial and Fiscal Implications

With the exception of subsidies, tax credits, and financial incentives which are generally not favored by the economic-instruments approach to environmental management, all other economic instruments have positive financial and fiscal implications.[5] Removal of distortionary subsidies (e.g., on fossil fuels, agrochemicals, water, etc.) would save substantial amounts of government revenue as well as generate additional taxes in the long-run through the enlargement of the tax base following the removal of the distortion. Environmental taxes, by virtue of being non-distortionary and corrective, generate additional government revenues at minimum cost. In fact, estimates by the Norwegian Statistical Office indicate that the costs of raising a tax dollar through conventional taxes is greater than one dollar (because of the distortion effect (e.g., disincentive for work) while the same dollar could be raised through environmental taxes at a cost of less than one dollar; in fact, at a negative cost (because of the correction effect). This corrective and revenue generating quality of environmental taxes contrasts sharply with the distortions, zero revenue (except from fines), and considerable expenditures associated with command and controls. There are, of course, issues as to whether the revenue from environmental taxes should be earmarked and used for environmental investments or go to the treasury to be used for general expenditure, or for the reduction of other taxes (e.g., income tax). This is an issue we address in the companion study on financing mechanisms. Revenue generated by user charges or full-cost pricing for wastewater treatment, road access, water use, or other public utilities are payments for services rendered and are retained by the utility for cost recovery.

On the other hand, tradeable emission permits, tradeable catch quotas, transferable development quotas, fishing licenses, and other forms of market creation do not automatically generate revenue, unless they are auctioned by the issuing authority, in which case they can generate substantial amounts of revenue. When they are given free of charge, the issuing authority may introduce a capital gains tax on the price of the permit or quota (which is likely to appreciate over time because of rising demand for permits against a fixed supply) to finance the administrative costs of issuing, registering, and monitoring the permits. Administrative fees may similarly be imposed for issuance of land titles, water rights, and transferable development rights to defray costs. Capital gains from these rights may also be taxed to raise general budget revenues.

The financing advantage of economic instruments has long been recognized by environmental policy makers in both developed and developing countries where pollution charges or property taxes are more often levied as sources of revenue than as incentives for more environmentally sound behavior. Hence, they tend to be set at a high enough level to generate the targeted expenditures (usually required to finance the enforcement and monitoring of command and control regulations), but not high enough to induce a change in behavior.

Despite the favorable financial implications of economic instruments over the medium to long term, depending on the instrument, a short-term cash flow problem may be created by the effort to introduce economic instruments such as secure land titles, water rights, fishing licenses, and tradeable emission permits, etc. The financial deficit may arise from the fact that property rights acquire value, (and can be used as collateral for access to financial markets) after they are issued. Since cadastral surveys, resolution of conflicting claims, and title issuance and registration take time (three to five years is not unusual), a cash flow problem is created for the issuing agency which assumes the cost without an immediate means of cost recovery. Given the severe scarcity of

[5] Pigouvian subsidies are an exception in that they may be the preferred instrument for the internalization of positive externalities and they do require fiscal or financial resources to implement. They could, however, be financed by “symmetric” Piguvian taxes as in the case where revenues from deforestation or logging taxes are used to finance reforestation incentives.

domestic financial resources in many developing countries, external financial assistance or borrowing are necessary for the implementation of certain instruments such as property rights. For example, Thailand in the 1980s received a $30 million loan from the World Bank, in conjunction with its structural adjustment program, specifically for the purpose of cadastral surveys, land registration, and titling.

Market creation instruments, such as tradeable emission permits or fishing licenses, may also face a financial problem because in order to secure acceptance by the industry, the government may allocate, free of charge, permits to all existing firms to cover fully their current emissions (grandfather system). Not only are the costs of establishing the system not recovered, but the government needs substantial additional financial resources to buy back a large number of permits or licenses in order to reduce emissions or fishing effort to the desired level. These costs can later be recovered through a capital gains tax on the market value of the permits, which will rise as more licenses are withdrawn and as demand for permits rises over time due to economic growth.

In conclusion, the introduction of economic instruments is generally a bankable project and even poor countries should be able to find the financial resources from development or environmental assistance or external borrowing to finance the short-term implementation cost. Alternatively, they can implement a cross-instrument subsidization; for example, the revenues from product charges can be used to finance the introduction of more sophisticated instruments such as tradeable emission permits.

CHAPTER 9 STRATEGY AND PROSPECTS FOR THE SUCCESSFUL INTRODUCTION OF ECONOMIC INSTRUMENTS IN DEVELOPING COUNTRIES

Economic incentives as instruments of environmental management in developing countries have many advantages over command-and-control regulations. First, they can achieve the desired effect at the least possible cost—this is vital to developing countries with limited resources and a dire need to maintain their competitiveness in world markets. Second, economic incentives are easier to enforce—this is important for countries with limited enforcement capability. Third, economic incentives present fewer opportunities for rent-seeking behavior than do regulations and therefore they are likely to both be more effective and more equitable. Finally, unlike regulations that require bloated bureaucracies and large budgets, economic incentives generate revenues which should be welcomed by countries facing tight budgets and budgetary deficits.

There is a large tool kit of economic instruments that can be used in support (or replacement) of command and control regulations. Each instrument has several variants and the potential combinations of instruments are practically infinite. Choosing the right instrument or combination of instruments for a particular problem and circumstance makes the difference between efficient and effective intervention that mitigates market failures and a costly distortion that worsens the allocation of resources and reduces social welfare. What works under one set of circumstances may be totally ineffectual under another.

Elements of a Successful Strategy

The level of development and structure of the economy are critical factors (because they determine enforcement needs and capabilities), as are social organization and culture. For example, in a country in a early stage of development with an economy dominated by agriculture, small-scale industry, and a large informal sector, regulations such as effluent standards and economic instruments such as effluent charges are likely to be ineffective because they are costly to monitor and enforce. Given the smallness, scattered distribution, and elusive nature of artisanal and small-scale industry, the costs of monitoring are likely to be high relative to the damage caused by the individual polluting activity; similarly, the administrative costs of collecting charges for such entities are likely to be large relative to the expected revenues. Under such circumstances the right intervention would be indirect instruments, such as product charges and differential taxes, imposed at easily monitored points (i.e., imports, exports, raw material production, etc.). Moreover, economic instruments in developing countries need to be at the same time both simpler and more sophisticated than in developed countries: simpler, because the developing countries have a limited administrative capacity for tax and charge collection; more sophisticated because the resource systems and ecology (especially in the tropics) are more complex than in temperate developed countries.

A successful selection of instruments has several distinguishing features. First, it is differentiated according to *scale of production*. In the case of a small number of large industrial conglomerates (as in Korea), emission standards, effluent charges, tradeable pollution permits, and even mandatory installation of pollution equipment can be effective because monitoring and enforcement are relatively easy. In contrast, a large number of small cottage industries call for indirect instruments such as input taxes, refundable deposits, and waste delivery incentives.

Second, successful environmental intervention is differentiated according to the *degree of competition*. Monopolistic or oligopolistic industries do not respond to economic incentives to the degree that competitive firms do because the demand for their product is more inelastic. Therefore, standards and mandated control equipment which do not depend on market response can be more effective in attaining the desired level of pollution control.

Third, a successful intervention is differentiated according to *ownership and control*. An industrial sector dominated by public enterprises facing a soft budget constraint or cost-plus pricing formulas does not respond to pollution charges or to fines for non-compliance, as the experience of Poland (under a command economy) and former East Germany demonstrates.

Fourth, a successful intervention is differentiated according to the *composition of industrial pollution*. Flexible systems, such as pollution charges/permits or inadequately enforced standards, are inappropriate if the pollution is dominated by waste for which the environment has no assimilative capacity (i.e., heavy metals, corrosive materials, or radioactive wastes). Strict regulations, manifest systems, performance bonds, and central collection treatment and disposal facilities are more appropriate.

Fifth, successful interventions consider explicitly the *monitoring and enforcement capabilities* and provide for an institutional support system. Where the feasibility of monitoring and enforcement is low and shut-down undesirable, mandatory installation of pollution control equipment may be preferable provided that effective use can also be mandated and monitored. Even then, taxation of inputs and performance bonds might be preferable because they have generally lower monitoring and enforcement costs.

Sixth, successful intervention accommodates *control region heterogeneity* (and hence, high information requirements) through the decentralization of authority to local agents and an allowance for locally tailored solutions; the more diverse or heterogeneous the control region is, the greater the need for locally tailored policies and instruments that automatically figure in the local conditions.

Seventh, for a policy intervention to be successful, the *acceptance by the industry* must be solicited and obtained. This is often accomplished through a new-source bias or grandfathering system that assures the industry that the objective is not punishment for past pollution but redirection of new investments towards less polluting technologies and industries. Gradual implementation is also necessary in order to allow time for industry adjustment and to preserve competitiveness. These allowances are temporary so as not to institutionalize inefficiency and sustain obsolete technologies.

The seven features of a successful policy intervention described above refer to the adaptability of the intervention to prevailing local conditions (e.g., the market structure, scale, the age and ownership of the industry, the composition of the waste flow, and the nature of the environmental media or receptor of wastes). The success of the instrument will ultimately be judged by its benefit-cost ratio, or at least cost-effectiveness. Benefits include the present value of avoided costs and the correction of distortions in resource allocation in addition to direct benefits, while costs include induced distortions in resource allocation in addition to the direct cost of enforcement by government and compliance by industry. The objective is not simply to treat and safely dispose of waste but to promote efficiency, to reduce waste, and in general, to induce a change in behavior more in line with the public interest while allowing flexibility for response and time for adjustment.

For a policy intervention to be truly successful in reducing overall emissions it must control intermedia substitution through an integrated emission reduction strategy for all media. Mandated use of scrubbers to control SO_2 from power plants should not result in increased water pollution, nor should wastewater treatment result in soil pollution through inappropriate disposal of slush.

Finally, a successful policy intervention would aim to reduce damage cost or at least environmental risk exposure rather than attainment of fixed ambient standards. This means that it takes into account the level of toxicity of pollutants, the pollution damage or risk exposure, and the cost of risk reduction for each pollutant.

The most critical first step to introducing economic instruments is to make the principles of eventual full-cost pricing and internalization of external cost acceptable to industry and the public in exchange for recognition of their legitimate concerns and the need for gradual introduction and adjustment assistance. Once the principles have been agreed upon, the next step is a gradual phase-in period, (usually 5-10 years), which is roughly the time it takes for the average-age capital stock to depreciate. In this manner future investments are generally directed towards a more desirable mix (e.g., less energy intensive, less polluting) without penalizing past investments. It is preferable for a country to begin with nominal charges—based on solid principles that earn wide acceptance and support—and to work its way to full implementation on a pre-announced schedule, than to go for a gamut of regulations that give the illusion of being firmly in command but leave the situation no further ahead in the future than it is today.

Another principle that needs to be observed is the minimization of enforcement/ monitoring requirements of the system and of the latitude for discretion by regulators. Compliance should be made in the interest of the resource user or the polluter. The regulators should be indifferent as to whether the polluter pollutes or pays, wastes or conserves water, cuts or plants trees. If the regulator is not indifferent then the price or charge is too low. The need to minimize regulatory, enforcement, and monitoring costs arises from the low enforcement capability in developing countries and the rent-seeking behavior that high charges and low salaries bring about. The ideal economic incentive is the one which is incorporated into the price of a resource or product; it can be avoided only by avoiding the use of the resource or product. Other instruments that meet this condition are refundable deposits, performance bonds, presumptive charges at clean-up-cost levels, transferable development rights, property and land use taxes, and transaction quotas. Hazardous waste management is an example where an imaginative combination of presumptive charges, performance bonds, and environmental auditing can be at least as effective as strong preventive measures and a lot more efficient (Panayotou, 1993).

Hybrid systems of economic incentives and regulations do exist but they should not be confused with a mixture of the two, arising from the unwillingness of regulators to depart from their command and control posts. In the hybrid systems the government sets a long-term target (e.g., ambient standard, rate of reforestation, water conservation) and market-based instruments are used to achieve the target at minimum cost.

By necessity, regulations and economic incentives are complementary instruments in the sense that a minimum amount of regulation (legal framework) is necessary for economic incentives to become operational. Similarly, without economic incentive, regulations either remain on paper or generate *de facto* financial flows through side payments. An efficient system is one that sets a broad regulatory framework which is implemented through a well thought-out and structured set of economic instruments.

CHAPTER 10 CONCLUSION

Policy makers charged with environmental management are generally faced with a difficult task to start with because environmental interventions are not perceived as productive activities but as breaks in economic activity. The task is even harder in developing and transitional economies in which environmental concerns are not only low on the list of priorities, but they are also perceived as drags on the development and restructuring efforts which are the top priorities—not only because they compete for scarce resources but also, and often primarily, because they weigh down on the economy at its critical take-off stage. This perception arises partly from a failure to recognize the linkages between environmental protection and the efficiency and sustainability of the development and restructuring process and partly from the dominant type of policy instruments used to implement environmental management. Command and control regulations are almost by definition additional constraints which are not welcome in a developing or transitional economy context in which there are already too many constraints (capital, foreign, exchange, government budget, technology, and institutions) and too few instruments to pursue a multiplicity of objectives. These reasons, along with the inherently limited enforcement capability within these economies (arising from the above constraints) account for the slow and rather reluctant progress of environmental management in all but a limited group of mostly developing countries.

Two rather recent developments, the concept of sustainable development and of economic or market-based instruments have fundamentally changed the landscape of environmental management in terms of both objectives and instruments. From being a luxury of primary concern to wealthy

countries, environmental protection has become one of the foundations of efficient and sustainable development; from being caught in an inevitable trade-off with economic growth, environmental management has become a source of growth, at least in the long run. The perception of the environment has changed from one of economic liability to one of a potential economic asset.

While the concept of sustainable development clearly enhanced the expected benefits of environmental management from one of an amenity to one of necessity, it did little by itself to lower its costs. More benefits of an essential nature do justify more effort in protecting the environment even in poor countries, but a high and sharply rising supply price quickly eats up the newly discovered benefits. The continued use of rigid command and control regulations that are insensitive to compliance cost differences among economic agents and fail to provide incentives for continued environmental improvement and technological innovation are not consistent with the positive view of environmental management in the context of sustainable development.

Enter economic or market-based instruments with the promise of flexibility, cost-effectiveness, and dynamic efficiency—all critical factors in development and restructuring efforts. Not only is more environmental management justified on account of lower costs, but the new incentive structure created improves resource allocation and promotes technological innovation. The premise of economic instruments is that environmental degradation and unsustainable development is a behavioral response to perverse market signals created by the failure to fully price natural resources and environmental assets and their products and services. The economic instruments approach to environmental management aims to correct the incentive structure by phasing out subsidies and other policy distortions and internalizing externalities and other social costs. Since full cost pricing is essential to both efficient environmental management and sustainable economic development and since the two are interrelated, the use of economic instruments to effect full cost pricing operationalizes the concept of efficient and sustainable development.

There is a large set of economic instruments to choose from and the choice is neither trivial or immaterial to the objectives of efficient environmental management and sustainable economic development. First, there is the choice of the right instrument or rather, the right combination of instruments that would best fit the specific conditions of the industry and county in question. Second, there is the choice of the level at which each instrument should be set to either ensure optimal environmental management or at least, attainment of stated environmental objectives at the minimum possible cost. Third, there is the choice of the pace of implementation or compliance schedule to minimize disruption and to ensure public support. Fourth, there is the choice of related or parallel policies necessary to address side-effects such as the regressivity of certain instruments (e.g., product taxes).

To inform this choice we reviewed the experience of selected developed and developing countries with a variety of economic instruments, including environmental taxes, emission charges, product charges, tradeable permits, refundable deposits, and environmental bonds among others. We concluded that while there is increasing interest in and use of economic instruments, the objective is more to raise financial resources than to change behavior or institute full cost pricing. Pollution charges are usually set too low to induce a major change in behavior, much less to attain an optimal level of pollution. Yet, this experience is suggestive of the potential gains from an incentive-based approach to environmental management. In addition to reviewing past experience, we examined the applicability of economic instruments to the special circumstances of developing countries and modalities and strategy for their successful introduction.

In the short-to-medium run, the best prospects for economic instruments in developing countries are first as sources of revenue and second as supports or supplements of command and control regulations. Economic charges may be introduced as enforcement incentives, tradeable permits, and credits as instruments to increase compliance with effluent or emission standards, and transferable development rights as supports of zoning regulations. The outright replacement of command and control regulations by economic instruments does not appear feasible at this time, and even if it were, it would be too disruptive. Economic instruments need to prove themselves before they can be trusted to attain society's environmental objectives; yet governments appear unwilling to set these instruments at levels that have an incentive effect on behavior. Nevertheless, it would mean substantial progress if economic instruments were to be introduced even as a source of flexibility and financing in conjunction with existing standards. By influencing investor expectations, a pre-announced schedule of escalation over time would create the right incentives long before the instrument attains its full force.

In the long run, the prospects for using economic instruments in developing countries (as in developed and transitional economies) are virtually unlimited. They are the fastest and least costly (and possibly the only) vehicle to sustainable development. Whether the concern is about excessive rates of deforestation and biodiversity loss, soil erosion and water shortages, CO_2 emissions or unsustainable consumption patterns, the source of the problem is underpricing and free riding. To the extent that economic instruments prove to be effective means of internalizing environmental and depletion costs and instituting full-cost pricing, they hold the key to environmental management and sustainable development. Proximate causes such as poverty, population growth, and over-consumption by the wealthy North would lose their potency without the nourishment from institutional, policy, and market failures.

ANNEX 1. Applications of Economic Instruments in Developed Countries

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
General				
Canada	SB	na		Accelerated depreciation for pollution control investments on plants commissioned before 1974[1]
France, Germany	SB	na		Accelerated depreciation for pollution control equipment[2]
Japan	SB	na		Special depreciation for 25 % of pollution control equipment investment[3]
Netherlands	SB	na		3-15 % investment tax credit for any environmental protection investment
Netherlands	SB	na		Grants and Loans to assist R & D projects[4]
Land and Soils				
Netherlands	C/RS	na	Manure surplus charge on excessive phosphorus	
Sweden, Norway, Finland	C/RS	1989-		Product charges on fertilizers and pesticides
USA	SB	1945-	Subsidy for soil conservation to farmers	
USA, France	TP	na	Rural transferable development rights trading (in U.S: Pinelands/NJ, Burlington/NJ, Montgomery/MD)[5]	
Water Resources				

[1] Jenkins/Lamech 1992a, p. 488 f.

[2] Jenkins/Lamech 1992a, p. 487 f.

[3] Jenkins/Lamech 1992a, p. 484.

[4] Jenkins/Lamech 1992a, p. 488 f.

[5] Stewart 1992, p. 556, Kayden 1992, Peters 1990.

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
USA	SB	1970-	Sewage treatment plant construction (to municipalities)	
USA, California	TP	1991-		Water banking and exchange of water rights[6]
Australia	TP	na		Water rights markets and auctions for new irrigation water 7
New Zealand	TP	1967-		Tradable water rights system
USA (Wisconsin)	TP	1981-	Permits for BOD loads to the Fox River	
France	SB	na	Subsidised loans to industry to reduce water pollution	
Portugal	C/RS	na	Water pollution charges	
Germany	C/RS	1960-	Pollution effluent charge 8	
Netherlands	C/RS	1969-	Pollution effluent charge	
Italy, France	C/RS	1976-	Pollution effluent charge (firms)	
UK	C/RS	1981-	Pollution effluent charge	
New Zealand, Iceland	TP	na	Transferable fishing quotas 9	
Toxic Chemicals and Hazardous Waste				
USA	C/RS	1983-	Waste effluent charge to waste site operators	
Belgium	C/RS	1981-	Waste effluent charge to firms	
Denmark	C/RS	1987-	Waste effluent charge to firms and households	
Sweden, Norway	C/RS			Product charges on batteries
Italy	C/RS			Product charge on plastic bags
Germany, Italy	C/RS			Product charge on lubricant oils
Netherlands	SB			Subsidy to industry for R&D & installation of pollution control equipmt
Congestion and Air Pollution				
Japan	C/RS	na	Air and noise pollution charges	

[6] Bhatia/Cessti/Winpenny 1993, p. 107 f.

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
Greece	C/RS	na	Air pollution charges	
Italy	C/RS	1989-	Airport noise charge	
Netherlands, UK	C/RS	na	Noise pollution charges	
Sweden	C/RS	na	SO2 and NO2 emission charges	
Switzerland	C/RS	na	Noise and air pollution charges	
most OECD	C/RS	1980-		Tax differentiation lead-free gasoline Cordon pricing in the Bergen and Oslo Toll Rings[10]
Norway	C/RS	1986-		
USA, Norway	C/RS	1987-		Passive electronic road pricing[11]
Sweden	C/RS	1992-		Electronic and manual zone fees in Active electronic road pricing (ERP) in Randstad area (experiment until 1995)[12]
United Kingdom	C/RS	1993-		Active ERP in Cambridge[13]
USA	C/RS	1994-		Passive electronic road pricing in Orange County Route 91, California 14
USA	TP	1982-87	Lead trading between refineries to reduce lead content of gasoline	
USA	TP	1976-	Air quality control area offsets (firm offsets outside area)	
USA	TP	1979-	Air quality control area bubbles (trading between sources in area)	
USA	TP	1992-	SO2 emission permit trading	
USA (Los Angeles)	TP	1992-	Ozone precursor (NOx, VOC, SOx) permit trading (RECLAIM) 15	
Human Settlements				
Sweden, Norway	C/RS			Product charge on beverage

[10] Hau 1992b.

[11] Hau 1992b, 33f.

[12] Hau 1992b, 5l.

[13] Hau 1992b, 55f.

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
				containers
Turkey	C/RS	na	Solid waste charge	
Germany	C/RS	1969-		Product tax on virgin oils for financing of subsidies for safe disposal/recycling
USA, France	C/RS	na	Landfill tax (NJ, PA, France) 16	
USA (New York)	TP	1970s		Landmark tradable development rights[17]
France, Switzerland				
Italy	SB	na	Recycling of old wastes	
Most OECD			Deposit refund on specific beverage containers and bottles	
Countries	DR	na		
Denmark	DR	na	Deposit on mercury and cadmium batteries	
Norway, Sweden	DR	1976-	Deposit refund on car hulks	
USA	other	1969		Incentive zoning in New York City, San Francisco, Anchorage, Cincinnati and Miami[18]
Global Climate				
USA	TP	1988-	CFC reductions trading	
USA, Denmark	C/RS	1989-		Excise tax on ozone-depleting chemicals[19]
Sweden	C/RS	1991-	Carbon Tax (SKR0.25 per kg)	
Denmark	C/RS	1992-	Carbon Tax	

NOTE: C/RS=Charge or removed subsidy; TP=Tradeable Permit; DR=Deposit-refund system; SB=Subsidy; EI=Enforcement incentive

ANNEX 2. Applications of Economic Instruments in Transitional Economies

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
General				
Poland	SB	na		Tax credit for 30% of investments in environmental

[17] Kayden 1992.

[18] Kayden 1992, Svirsky 1970, Cook 1980, Getzels/Jaffee 1988.

[19] Jenkins/Lamech 1992b, p. 529.

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
				protection, if project compeleted within 5 years
Poland	SB	na		Subsidized credit (50% of interest) for investments in pollution abatement
Russia	C/RS	1990-	System of emission, effluent and solid waste fees based on zero-threshold step function or assessment[20]	
Water Resources				
Czechoslovakia, Hungary, Poland	C/RS	na	Pollution effluent charges	
Toxic Chemicals and Hazardous Waste				
Poland	C/RS	na	Charge on dumping and storage of non-recyclable industrial waste[21]	
Human Settlements				
Poland	C/RS	na	User charge for collection and treatment of municipal solid waste	

NOTE: C/RS=Charge or removed subsidy; TP=Tradeable Permit; DR=Deposit-refund system; SB=Subsidy; EI=Enforcement incentive

ANNEX 3. Applications of Economic Instruments in Newly Industrialized Economies and Middle-Income Countries

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
General				
South Korea	SB	na		10% investment tax credit (3% for imported equipment) for pollution control equipment[22]
South Korea	SB	na		Accelerated depreciation (50% for domestic, 30% for imported) for new technologies[23]
Taiwan	SB	na		Accelerated depreciation and investment tax credit 5-20% depending on type of asset

[20] Palmisano/Haddad 1992.

[21] Wilczynski, in Er^cal (ed) 1991, p. 353 f.

[22] Jenkins/Lamech 1992a

[23] Jenkins/Lamech 1992a

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
Water Resources				
Brazil	C/RS	1978-	Effluent charges in Sao Paulo[24]	
Malaysia	C/RS	1978-	Rubber and palm oil mill effluent charges cum water quality standards[25]	
Congestion and Air Pollution				
Singapore	C/RS	1975-		Central zone car licensing fee Passive electronic road pricing and area licensing scheme[26]
Hong Kong	C/RS	1983-		
Mexico	C/RS	na		50% increase in gasoline prices (implicit emission tax)[27]
Human Settlements				
Egypt, Syria, Lebanon	DR	na	Deposit refund on glass, carbonated beverage containers	

NOTE: C/RS=Charge or removed subsidy; TP=Tradeable Permit; DR=Deposit-refund system; SB=Subsidy; EI=Enforcement incentive

ANNEX 4. Applications of Economic Instruments in Developing Countries

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
Land and Soils				
Indonesia	C/RS	1985-		Removal of pesticide subsidies
Forests				
Cameroon	C/RS	na	Fixed and variable taxes on land area and amount of timber harvested	
Water Resources				
India	C/RS	na	Mix of water tariffs, pollution charges and	

[24] Bhatia/Cessti/Winpenny (1993), p. 85 f.

[25] Raman/Vincent 1994.

[26] Hau 1992b, 44 f.

[27] Eskeland 1993, 30.

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
			fiscal incentives in Jamshedpur[28]	
India	TP	na		Groundwater markets in Punjab, Uttar Pradesh, and Haryana<tfn>29</tfn>
PR of China	C/RS	1985-		Irrigation service fees Decentralization of authority to local water management agencies
Congestion and Air Pollution				
PR of China	TP	1985-	Pollution discharge permit system, Beijing<tfn>30</tfn>	
PR of China	C/RS	1985-	Emission fee and fine collection system, Beijing<tfn>31</tfn>	
Human Settlements				
India	DRS	na	Deposit refund on glass, carbonated beverage containers	

NOTE: C/RS=Charge or removed subsidy; TP=Tradeable Permit; DR=Deposit-refund system; SB=Subsidy; EI=Enforcement incentive

ANNEX 5. Applications of Economic Instruments in Developed Countries

COUNTRY	TYPE	PERIOD	DIRECT INSTRUMENTS	INDIRECT INSTRUMENTS
Forests				
Global (proposed)			System of tradeable forest protection and management obligations[32]	
Toxic Chemicals and Hazardous Waste				
Thailand				Posting of performance bonds based on projected levels of hazardous wastes[33]

NOTE: C/RS=Charge or removed subsidy; TP=Tradeable Permit; DR=Deposit-refund system; SB=Subsidy; EI=Enforcement incentive

Sources: This matrix was compiled from a variety of sources listed in the bibliography with the assistance of Martin Wolfrum.

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