Economic Incentives for Environmental Protection: Integrating Theory and Practice

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For decades, economists have been extolling the virtues of market-based or economic-incentive approaches to environmental protection. Some 70 years ago, Arthur Cecil Pigou (1920) suggested corrective taxes to discourage activities that generate externalities. A half century later, J. Dales (1968) showed how the introduction of transferable property rights could work to promote environmental protection at lower aggregate cost than conventional standards. From these two seminal ideas—corrective taxes and transferable property rights—a substantial body of research has developed.

Both environmental taxes and marketable permits are coming of age in the policy arena. Examples include the introduction of marketable permits in the United States to control acid rain, the use of charges in Europe to limit air and water pollution, and the employment of deposit-refund schemes for products ranging from beverage containers to batteries. The introduction of these tools on a large scale provides a unique opportunity to extend the frontiers of knowledge. This essay strives to identify prominent issues that merit investigation.

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I. Alternative Policy Instruments

Although some policymakers would likely claim that the singular objective of environmental regulation is to protect environmental quality, the decision problem actually faced by policymakers is far more complex, involving trade-offs among multiple objectives. In the economist's version of public-policy heaven, the objectives for policy will typically be efficiency (maximizing net benefits) or cost-effectiveness (choosing the least costly method for achieving a goal). Efficiency and cost-effectiveness, however, are by no means the only possible criteria for judging environmental policies. Other considerations might include overall effectiveness, ease of implementation, equity, information requirements, monitoring and enforcement capability, political feasibility, and clarity to the general public.

Economists frequently divide policy instruments for achieving environmental objectives into two categories: those that provide firms with little flexibility in achieving goals (so-called "command-and-control" approaches) and those that provide firms with greater flexibility and incentives to look for more effective ways of making sustained environmental progress (so-called market-based or incentive-based mechanisms).

Comparisons between conventional command-and-control regulation (including technology standards and performance standards) and market-based approaches (including taxes and markets in pollution rights) have repeatedly noted that conventional regulations fail to achieve environmental objectives in the least costly manner. In contrast, well-designed market-based approaches provide an incentive for firms to

equate abatement costs at the margin, thus achieving a given level of environmental quality at least cost. For example, simulations suggest that the proposed emissions-rights market for curbing acid rain in the United States could save $1 billion annually in comparison to a command-and-control approach in which scrubbers would be required on selected power plants. In theory, a similar result could be achieved through the introduction of an appropriately scaled emission tax.

The marked preference economists have shown for incentive-based instruments over command-and-control is largely based on their theoretical efficiency advantages in highly stylized situations. Given political and technological constraints, however, there are some environmental problems for which incentive-based approaches are poorly suited. For highly localized pollution problems with threshold (nonlinear) damagé functions, source-specific standards may be appropriate, whereas for pollution problems characterized by more uniform mixing over larger geographic areas, market-based approaches may be particularly desirable. If market-based mechanisms are considered, the investigation should include not only charges and tradable permits, but also deposit-refund schemes, strategies to reduce government barriers to market activity, and means of eliminating or at least reducing government subsidies.

II. Policy Design and Evaluation

Some measure of static efficiency is used in most economic analyses of policy instruments. In some cases, the measure may include explicit calculations of the benefits of pollution control, but in most cases, a cost-effectiveness measure is utilized. Conventional standards are frequently compared with some market-based system, and potential gains from trade in permits or efficiency gains from charging a pollution fee are simulated.

As implemented, this approach tends to exhibit two major problems. First, it generally assumes that all gains from trade will be achieved, independent of the firm's regulatory environment. Such assumptions may be reasonable in markets characterized by low transactions costs and few regulatory distortions, but they are not necessarily reasonable in situations where firms are heavily regulated. For example, the dominant players in the sulfur dioxide (SO_2) tradable allowance program for acid rain, codified in the 1990 amendments to the Clean Air Act, will be public utilities. This act made no attempt to ensure that state public-utility commissions would adopt or consider regulations that would give appropriate incentives to electrical utilities to participate in the trading program. Yet, such regulations are likely to be critical to the success of the market. For example, if regulated utilities cannot retain some fraction of the benefits from trading, they will have little or no incentive to engage in trades.

Second, in carrying out empirical investigations of actual applications of market-based policy mechanisms, many analyses use highly stylized benchmarks for comparison that ignore likely political constraints. Thomas H. Tietenberg (1985) assimilated the results from ten analyses of the costs of air-pollution control, and in a frequently cited table, indicated the ratio of cost of the actual command-and-control program to a least-cost benchmark for each case. Unfortunately, the resulting ratios (which ranged from 22.0 to 1.1) have been taken by others to be directly indicative of the potential gains from adopting specific ("cost-effective") mechanisms such as tradable emission permits. A more realistic comparison would be between actual command-and-control policies and either actual trading programs, such as the U.S. Environmental Protection Agency's bubble policy, or a reasonably constrained theoretical permit or charge program.

A special case of this problem is that economists typically estimate the gains from trade in moving to a market-based system in which there are no transactions costs, even though previous work on actual applications suggests that transactions costs in tradable-permit markets can be substantial. With transaction-cost functions of the form experienced in practice, however, the quantity of

transactions, the equilibrium allocation of permits, and hence the aggregate costs of control (degree of relative cost-effectiveness) are sensitive to the initial permit allocation.

In addition to static efficiency, dynamic incentives provided by alternative policy mechanisms provide a useful criterion for policy evaluation. In the long run, the effect of public policies on technological change may be among the most important determinants of success in environmental protection. For example, much of the policy discussion regarding the threat of global climate change has centered on alternative means of increasing energy efficiency, whether in production or consumption. Economists, of course, have a simple answer of how to achieve the efficient level of diffusion of any energy-efficient technology: set the prices correctly, such as through carbon taxes, and let the market do the rest. Engineers, lawyers, and most politicians do not see it quite this way; they tend to be more interested in using energy-efficiency standards, whether for motor vehicles, home appliances, or home construction.

The debate has until now rested largely on theory. Economists continue to claim that market-based policies will not only be cost-effective (in a static sense), but will also provide dynamic incentives for the development and adoption of improved pollution-control technologies. In the absence of empirical research, this remains largely an untested hypothesis. This need not be the case. By drawing upon our experiences with market-based and command-and-control policies and by investigating some "natural experiments" with changing energy prices, it is possible to investigate empirically the relative effectiveness of these two categories of policy mechanisms in terms of their relative impacts on the diffusion of improved technology (Adam B. Jaffe and Stavins, 1991).

It should also be recognized that the standard theory of factors affecting dynamic efficiency may need to be revised in the light of political constraints. For example, it is not clear that governments are capable of making the type of long-term credible commitments under markets that would be required to encourage affected firms to adopt new and improved technologies. The real challenge is to compare paths of technological change under political institutions that use standards with other feasible regimes that use market-based instruments.

Given the broad range of criteria by which environmental policies can be evaluated, it is important that economists begin to move beyond their traditional reliance upon efficiency and cost-effectiveness for judging the efficacy of alternative means of reaching policy goals. Whether singly or in combination, other legitimate criteria of success should be considered, principal among these being the relative distributional equity or fairness associated with specific policies. Alternative notions of "equity" may mean the difference between life and death for new policy proposals in the political realm. For example, one of the major challenges in developing a substantive agreement for controlling greenhouse gas emissions will be to define de facto emission rights in ways that satisfy all parties to such an agreement.

III. Why Policy Instruments Are Chosen

In contrast with the substantial amount of work that has been done by economists on designing market-based approaches to environmental protection, relatively little effort has been devoted to developing or testing a positive theory of environmental instrument choice. One problem with current models of instrument choice is that they lack the detail required to provide guidance in specific policy situations. Moreover, they do not help distinguish among the array of instruments that are actually applied.

To begin developing such a theory, it would be useful to focus on the incentives faced by key decision-makers and the institutions and environments in which they function. Some work has been done on the impact of procedures and rules implemented by Congress (Matthew McCubbins et al., 1989), but neither the House of Representatives nor the Senate is a key player in defining the details of many environmental policies. Indeed, a striking feature of many Federal environmental policies is the

extent to which program staff within EPA play a central role in developing and advancing options. Finally, it is necessary to include the role of environmental organizations in any comprehensive model of instrument choice, since these groups play an increasingly important role in shaping national policy (Hahn, 1990).

A more careful and comprehensive articulation of a positive theory of instrument choice will lead to a richer statement of available alternatives. Theoretical modeling is necessary but not sufficient for full understanding. It would be useful to complement this investigation with a more rigorous analysis of factors affecting the adoption of particular instruments for environmental protection, building on earlier work by Steven Kelman (1981).

IV. Implications for Policy and the Profession

The decade of the 1990's may be remembered as a full-employment period for environmental economists; one of the key factors fueling the demand for services will likely be continued experimentation with a variety of market-based approaches for environmental protection. In the midst of this heightened interest over market-based environmental policies, the distinction between goals and means has become blurred. While little attention is paid to the desirability of particular objectives, the policy community seems to have become somewhat mesmerized by the possibility of using markets and other incentive-based approaches to achieve those objectives. Economists can play an important role not only in designing more cost-effective policy mechanisms, but also in the selection of more efficient policy goals.

Although economists have developed some useful insights regarding marketable permits and effluent fees for environmental management, it is time to move to a more realistic statement of the problems that need to be solved. Both theory and empirical analysis can be useful in the design and evaluation of market-based instruments. It is clearly unlikely, for example, that the tradable-permit program adopted in the recent Clean Air Act amendments would have even been considered had economists not developed the idea over the previous decade. Thus, there remains a need for economists to develop and test new instruments, such as the auctions contained in the new acid-rain control program (Robert Franciosi et al., 1990).

The search for new instruments should recognize that appropriate mechanisms will vary depending on the relevant government agency's resources and capabilities. Much of the work on markets and emission taxes assumes that there is a reasonably sophisticated environmental control agency that can administer incentive-based programs. This may be a reasonable assumption for many industrialized nations, but it is probably the exception, rather than the rule, in many developing countries. The design of incentive-based instruments that require less administrative expertise and fewer resources to implement could facilitate more applications.

The research agenda of environmental economics can do a better job of informing the quest for better public policies. It should be recognized, however, that most of what is already known about the design of market-based approaches for environmental improvement has yet to be assimilated by policy makers. This assimilation is unlikely to occur unless economists become more aware of the environmental policy process, since such awareness is a prerequisite for more relevant research. At present, however, the incentive structure faced by most academic economists works against such concerns. This is unfortunate, since environmental economics *can* make a real difference in the world in which we live.

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