Using Economic Incentives for Environmental Policy

by

Jeffrey K. MacKie-Mason
University of Michigan and National Bureau of Economic Research

July 21, 2008

Address. Prof. J. MacKie-Mason, Dept. of Economics, University of Michigan, Ann Arbor, MI 48109-1220. Internet: jmm@umich.edu. Bitnet: usergc76@umichum.

Using Economic Incentives for Environmental Policy

Jeffrey K. MacKie-Mason

There is a rather remarkable and surprisingly uncontroversial result in economic theory known as the Second Welfare Theorem: under certain idealized conditions, a competitive free-market economy will achieve Pareto optimality. Pareto optimality is a widely-accepted, weak condition for a well-functioning economy: there are no changes that can improve one person's welfare without harming at least one other person. All undisputable welfare improvements have been made. However, the conditions required for competitive markets to have this property are far from the conditions of real economies. The central tasks of environmental economics are to identify *market failures* that prevent Pareto optimality, and to design remedies for these failures.

Externalities are the most pervasive type of market failure. An externality is present when the activity of one person has an inadvertent impact on the well-being of another person. Environmental externalities are common because the use of many resources imposes costs on society, but the user of the resource is not charged a price equal to the cost imposed. For example, the smoke emitted by a factory unintentionally worsens air quality for nearby residents. The factory owner pays for the steel and oil used in production, but not for the use of clean air.[1]

Externalities prevent the achievement of Pareto optimality because the polluter does not equate his or her incremental benefit of generating a bit more pollution to the incremental social cost of that pollution. To see this, suppose a factory can lower its production cost by buying much dirtier but slightly cheaper coal. The benefit to the factory is a small cost savings. The cost to society is the greater air pollution. If the factory owner keeps the cost savings and doesn't bear the cost of dirty air, even the smallest cost savings will be pursued, no matter how dirty the coal. Suppose the cost savings is $1, but the social cost of

---

To appear in *The Encyclopedia of the Environment*, Houghton-Mifflin, 1993.

[1] Henceforth polluting activities will be used to illustrate the points. Pollution is not the only type of environmental externality, of course: global warming and the loss of wilderness are two other examples.

the additional pollution (say, from additional lung disease) is $10. A Pareto improvement is possible by stopping the use of the dirtier coal, while transferring $1 from the neighbors to the factory owner. The factory owner still gains $1, while the neighbors pay only $1 to gain $10 in clean air benefits.

When costly side effects can be ignored by a polluter, there will be too much pollution relative to a Pareto optimum. Several policies can give polluters an *economic incentive* to consider side effects when deciding how much pollution to generate.[2] The three most important economic incentives are taxes, subsidies, and tradable permits. These all work by *internalizing the externality*, that is by making the polluter directly face the cost created by the pollution.

Taxes. Since 1920 economists have recommended imposing a tax on polluting activity equal to the incremental social cost imposed by that activity (A. C. Pigou, 1920). Then as long as the social cost of the pollution is greater than cost of prevention or clean-up, the polluter will want to reduce the pollution, to the point at which the social benefits of further reductions are not sufficient to warrant the costs of obtaining the reductions. A Pareto optimum can be achieved.

Subsidies. Rather than impose a tax to discourage pollution the government can offer an equal subsidy per unit of reduction. A subsidy per pound of gunk *reduced* creates the identical incentive as a tax per pound *produced*: each pound of gunk eliminated raises profits by the amount of the subsidy or tax. The main difference between taxes and subsidies is distributional: the cost of control can be paid by taxpayers (through a subsidy), or by some combination of the factory's owner, workers and customers (through a tax).

Tradable permits. A very different approach to using economic incentives for environmental problems is to create a market in which the polluter must pay a price for the use of the formerly unpriced input (*e.g.*, clean air). The usual method is for the government to issue permits for a fixed amount of gunk and to allow individuals and firms to buy and

[2] When the noxious activity costs the victim more than it costs to prevent, the problem may be resolved through negotiation and side payments. Although negotiation may work well for disputes between neighbors, most environmental problems involve too many people for negotiations to be feasible. For instance, one factory's smoke may harm millions of residents over thousands of square miles. In general, correcting environmental externalities will require some form of government intervention.

sell the permits (Dales, 1968). The fewer the permits the higher will be their market price. By controlling the quantity of permits the government can control the permit price so that the polluter has to pay the same amount per pound of gunk as it would under a tax or subsidy. Thus, all three methods can solve equivalently the problem of equating the costs and benefits of externalities, while using the polluter's self-interest to obtain the socially desirable level of control.

One advantage of using these economic incentives is that a given level of pollution control can be attained at the least cost. For example, with tradable permits, the permits will be most valuable to polluters with the highest control costs; they will purchase the permits, while those with lower control costs sell their permits and reduce their pollution. This result contrasts with the use of emission standards: all polluters must to control to a given level, even though it will likely be cheaper to have some polluters control a bit more while others control an equal amount less.

As simple and effective as economic incentives seem for environmental remedies, there are a number of complicating problems. For example, when there is uncertainty about the benefits or costs of control, taxes and tradable permits are no longer equivalent. Which method is more effective depends on the shapes of the incremental cost and benefit functions (Weitzman, 1974).

Another problem is that the effectiveness of economic incentives depends on the competitiveness of the markets in which polluters operate. Suppose a polluting firm is a monopolist. Polluting monopolists impose two costs on society: the pollution generated, and a reduction in production in order to raise price and profits. Imposing a pollution tax on a monopolist reduces the pollution but simultaneously exacerbates the problem of too little production. Thus a tax may actually make society worse off (Buchanan, 1969). More generally, any time there are other market imperfections aside from the pollution externality of concern, economic incentives are not guaranteed to raise social welfare. The incentive policy may reduce pollution appropriately, but interact unfavorably with the other market imperfections, causing some social loss to offset the gains from pollution control.

A third serious difficulty is that severe external harms can lead to problems for policy design known as non-convexities, and corrective taxes are no longer guaranteed to achieve a

Pareto optimum. Indeed, the usual incentives policies may make society worse off (Baumol and Bradford, 1972). In particular, it is difficult to design effective economic incentives policies when an environmental problem is likely to cause severe and irreversible damage.

Despite the problems with economic incentives policies, most economists view incentives approaches to be more effective than alternatives. However, there has been substantial recent attention to various practical implementation problems that throw further doubt on the universal preferability of incentives policies. These problems include the possibility that other, non-economic objectives are important (such as equity and administrative simplicity), political contraints, high monitoring costs and other technological limitations (Hahn and Stavins, 1992).

Research on the possibilities and limitations of economic incentives for environmental remedies is an active area. Meanwhile, many recent policies have been based on economic incentives. These include the use of tradable permits for leaded gasoline, chloroflourocarbons and SO_2 emissions; deposit-refund systems for beverage containers and lead batteries; and taxes on toxic solvent wastes and carbon dioxide.

For more thorough treatments of this material, see Schelling (1983) (nontechnical), Baumol and Oates (1988), or Fisher (1981, ch. 6).

References

Baumol, W. and D. Bradford (1972) "Detrimental Externalities and Non-Convexity of the Production Set," *Economica*, **XXXIX**, 160–76.

Baumol, W. and W. Oates (1988) *The Theory of Environmental Policy, 2nd ed.*. Cambridge, UK: Cambridge University Press.

Buchanan, J. M. (1969) "External Diseconomies, Corrective Taxes, and Market Structure," *American Economic Review*, **LIX**, 174–77.

Dales, J. (1968) *Pollution, Property and Prices*. Toronto: University Press.

Fisher, A. (1981) *Resource and Environmental Economics*. Cambridge, UK: Cambridge University Press.

Hahn, R. W. and R. N. Stavins (1992) "Economic Incentives for Environmental Protection: Integrating Theory and Practice," *American Economic Review*, **82**, .

Pigou, A. C. (1920) *The Economics of Welfare*. London: Macmillan & Co..

Schelling, T. (1983) "Prices as Regulatory Instruments," in *Incentives for Environmental Protection*, ed. Schelling, T.. Cambridge: MIT Press.

Weitzman, M. L. (1974) "Prices vs. Quantities," *The Review of Economic Studies*, **XLI**, 477-99.