ECONOMIC INSTRUMENTS

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Summary

The use of market-based economic instruments has emerged as a more flexible alternative to the traditional command-and-control regulatory approach to controlling emission of pollutants in market-based economies. Such instruments can generally be divided (generically) into taxes and emission permits, although both categories contain a large array of distinctly different forms of instruments depending on the ultimate intention of their application. This article compares the relative benefits and drawbacks of regulation and instruments in theoretical and contemporary applied contexts. In particular, the benefits of using economic instruments to control emissions from energy use are discussed in detail, although application of such instruments remains in its infancy.

1. Introduction

The closing decades of the twentieth century witnessed a worldwide increase in the prominence of environmental issues, and formal consideration of the impact on the environment of new development proposals is now mandatory in most countries.

Complementing this rise in awareness of the impact of human activities on the environment has been an attempt by many governments, often forced into action by high-profile "green" organizations, to provide significant resources for research and education to raise the community's awareness of domestic environmental concerns. There is, however, considerable debate as to how the full environmental costs of various human activities can be evaluated and how charges can be imposed on the polluters to compensate for the environmental "damage" they create.

The scale of the problems that must be addressed are many and varied, ranging from localized pollution of highways through anti-social dumping of refuse to the prospect of global climate change resulting from human activities augmenting the natural "greenhouse effect". The corresponding policy options for dealing with such problems are also very varied, as are the costs of implementing such options.

Ironically, the very mechanism that has encouraged excessive environmental damage in much of the world, and hence contributed significantly to its accompanying high social costs—the market place—is seen as one important avenue by which environmental objectives and targets could possibly be met at a lower cost than by traditional regulatory measures. However, to do so effectively, the market failures that have contributed to so much of the problem in the first place need to be corrected.

The proposal to impose taxes on pollution is far from new, having been proposed at the turn of the century by the famous British economist Professor Arthur Cecil Pigou as a means of reducing London's famous fogs. Pigou observed that pollution imposed uncovered costs on third parties that were not included in ordinary market transactions. His proposal was to tax pollution by means of a so-called externality tax in order to internalize within ordinary market transactions the damages caused by pollution. While Pigou was a founder of welfare economics in many ways, and thus an important source of inspiration for the subsequent welfare state, the external tax was at that time regarded as a rather academic approach to the control of pollution, and was not regarded as being of any practical significance.

In this article the logic underpinning the use of economic instruments (which may be loosely grouped as taxation and permit based) for addressing various energy policy objectives is described. It is contrasted with direct regulation that has been the dominant method to date, and the applicability of the tools through which the objectives of policy are to be achieved. Various economic instruments have also been designed for use outside of the energy sector, but in the context of natural resources management.

2. Internalizing Externalities

In a market economy, economic agents typically only consider private (i.e. to themselves) costs and benefits when planning levels of production, consumption, and investment. The economic and social consequences of environmental degradation are not generally translated into private costs to be borne by the polluter. Indeed, in a competitive framework, economic agents would have an in-built tendency to transfer such social costs onto others or into the distant future.

Such costs (or benefits) are generally known as "externalities" since they are borne by third parties irrespective of whether or not they wish to experience them. It is not possible for an individual person or nation to purchase less of the "good" using the conventional market mechanism. Coase has argued that the problem of externalities was due to the lack of property rights. In its simplest form, the Coase theorem asserts that the most efficient solution to pollution damage situations is a bargaining process between polluter and sufferer based on a clear definition of property rights. If the polluter has the right, the sufferer can pay him not to pollute; if the sufferer has the right, the polluter can compensate him to tolerate damage. Thus the "cost" of the final decision is shared between the two parties without external intervention. In fact Coase showed that, provided the costs of making such transactions are negligible and affected parties can negotiate freely with each other, an efficient allocation would take place irrespective of which party was allocated the right (although the distribution of costs and benefits among the affected parties would change). Not surprisingly, the cost is borne by the person not owning the right.

Consider the example of a rock band that conducts its practice sessions in the residence of one of its members, much to the discomfort of neighboring residents. If the group has the "right" to make noise, then the neighbors would have to negotiate a solution whereby the noise level was lowered, or practice was undertaken at a less disruptive time of the day, in return for some benefit (maybe financial) to the rock group. However, if the neighbors as a group held the "right" in the form of absence of noise, then if the rock group wished to practice it would have to negotiate a compensation package with the neighbors. A possible inefficiency that may arise if the "right" is assigned to the rock group is the proliferation of such rock groups established simply to receive compensation (bribes?) in return for noise moderation.

Theoretical and practical reasons have been put forward as arguments for the inability of the Coase theorem to provide a solution to the attainment of an optimal level of pollution. Briefly, these are:

- transaction costs, which Coase assumes to be zero, may be of such significance that they prohibit achievement of an optimal bargaining solution;

- Coase also assumes wealth effects to be zero. The person assigned the property right becomes a beneficiary of a transfer of wealth. Provided the income elasticity of demand is not zero, this transfer would shift the demand curve to the right.

Where individual negotiation of property rights becomes impractical, then the injured parties can resort to "liability rules". These are rules which award monetary damages, after the fact, to the injured parties, with the amount of the award designed to correspond to the amount of damage inflicted. Such decisions create precedents, giving potential offenders advance knowledge of the cost of their actions. An example would be the incentives to prevent oil spills facing an oil company which are transformed once it has had to clean up after an oil spill and to compensate fishermen for reduced catches. It quickly becomes evident that accident prevention is cheaper than retrospectively dealing with the damage once it has occurred.

However, if transaction costs are high, the number of parties involved in a dispute is large, and the circumstances are common, then the inefficiency tends to be corrected by government regulation.

Historically, regulatory instruments have been the basic mechanism for enacting environmental policy throughout the industrialized world. Environmental quality is seen as a public good that the state must secure by preventing private agents from damaging it. Direct regulation involves the imposition of standards regarding emissions and discharges, product or process characteristics, and so on, through licensing and monitoring. Legislation usually forms the basis for this form of control, and compliance is generally mandatory with sanctions for non-compliance. The standard is set either on the basis of scientific opinion of the adverse health or ecological effects of the pollution in question, or by making a social or political judgement of the value to the public of the environmental good in question.

Over the past two decades, so-called "market-based" approaches to addressing environmental problems have become popular, although their history dates from earlier seminal works by Pigou and Dales, and regulation is commonly viewed as lacking in flexibility and being sub-optimal in terms of environmental and economic efficiency. The argument may be summarized as follows:

- Regulation will only produce an economically efficient (i.e. least cost) solution to meeting a given environmental standard by accident.

- Regulation may discourage new economic and technological abatement initiatives, since polluters do not incur a financial penalty for their emissions provided they remain below the standard.

- Regulation does not fully take into account differences in abatement costs between polluters, so an economically sub-optimal distribution of abatement devices will occur.

Consider again the example of our rock group. If legislation were enacted such that noise levels were not permitted to exceed a certain standard anywhere in the city concerned, then there would be no incentive for the rock group to modify its behavior other than to ensure compliance with the new standard (of course, if the penalties for non-compliance were regarded as trivial or non-enforceable, then it may ignore the standards completely). The inefficiencies associated with this solution are very evident:

- Without a significant amount of resources being allocated to research into the effects of varying noise levels on local communities (i.e. calculation of the cost of damage caused by the noise pollution), the level of the standard can only be set arbitrarily.

- There is no incentive for behavior modification. The rock group has no incentive to move to an area where its "desired" noise level may be less "costly" to local residents than its current location or to play at less disruptive times of the day.

The legislation could be amended to accommodate these problems, but by now it should be apparent that the cost of achieving a reasonable approximation to an efficient solution (and policing it) would be far from trivial.

3. Economics of Emission Control

Emissions can generally be categorized as either "fund" or "stock" pollutants. Stock pollutants accumulate over time as emissions enter the environment, since the latter has inadequate or no absorptive capacity to deal with them. Examples could include current global production of nuclear waste and roadside dumping of beer cans. Pollutants for which the emissions rate does not exceed the absorptive capacity of the environment are called fund pollutants. Essentially the latter are transformed into substances that are not considered harmful to people or to the ecological system. Global emissions of carbon dioxide (CO_2) should fall into this category, since they are absorbed by plant life and the oceans. Today, however, emissions are too high for the earth's absorptive capacity to prevent accumulation of CO_2 as a stock in the atmosphere.

Since pollution is a classic externality, markets will generally produce more than the efficient amount of both fund and stock pollutants. For both pollutants this will imply higher than efficient damages and lower than efficient control costs. In addition, for stock pollutants an excessive amount of pollution would accumulate in the environment, imposing a detrimental externality on future, as well as current, generations.

Unlike the case of increasing scarcity of a natural resource, the price mechanism would not automatically adjust to offset this additional "cost" of pollution. In fact, firms that take unilateral action to control their own emissions will be placed at a cost disadvantage to those ignoring their emissions. Hence the requirement for some form of government market intervention

Assume that the government wishes to introduce an emissions standard to control a certain pollutant, and is willing to impose a penalty if this standard is exceeded. In Figure 1 the level of pollution and economic activity are measured (separately) along the horizontal axis, and valuation of costs and benefits in monetary terms are measured on the vertical axis. MNPB is "marginal net private benefits", i.e. the extra net private benefit from changing the level of activity by one unit. MND is "marginal net damages", i.e. the value of the extra damage done by pollution arising from the level of economic activity (which is assumed to increase as output increases). The point of intersection of the MNPB and MND curves (for simplicity, both are assumed to be straight lines) gives the optimal level of the externality; with P* indicating costs/benefits associated with this equilibrium position, and Q* and W* the associated levels of economic activity and pollution respectively.

Now assume a standard is set which corresponds to a level of pollution W_s and a corresponding level of economic activity Q_S. In addition, the penalty for exceeding the standard is determined to be P. Clearly this standard will not be optimal, since it does not coincide with Q*. It has been set too high. However, as a result of the regulatory authority setting Q_S too high, P has also been set too low. Thus, the polluter has an incentive to pollute up to Q_b because the total penalty up to Q_b is less than the net

private benefits from polluting. Beyond Q_b, further pollution attracts a penalty in excess of marginal net benefits and so the polluter has no incentive to move beyond that point (assuming the regulatory authority polices the standard).

Adapted from: Pearce D. W. and Turner R. K. (1990). *Economics of Natural Resources and the Environment*, Harvester Wheatsheaf, London.

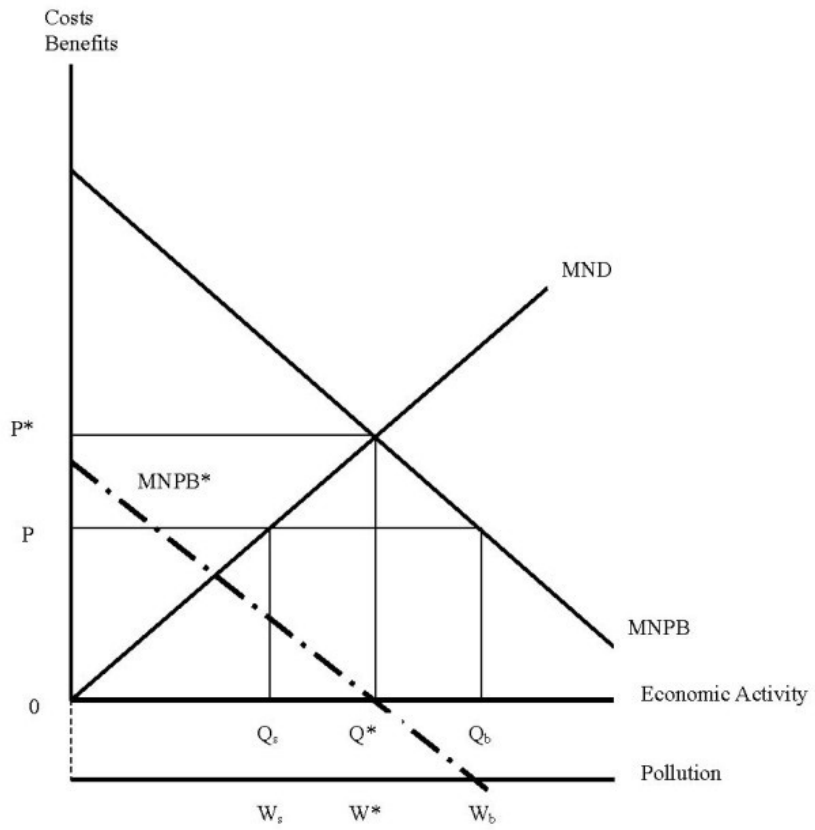

Figure 1. The Inefficiency of Standards

Thus for a standard to be efficient it must ensure that pollution is held at Q* *and* the penalty for exceeding the standard must be set at P*. In addition, enforcement of the standard must be guaranteed. The difficulty of achieving these conditions has encouraged economists to look to market-based alternatives for optimal control of pollution.

The desired goal is to determine how to reach the socially optimal level of pollution, Q*. If a tax (equal to t*) is imposed on each unit of the level of activity giving rise to pollution, the effect of this tax would be to shift the MNPB curve to the left, to MNPB* (i.e. MNPB – t*). The polluter now aims to maximize private net (after tax) benefits, and this occurs at Q*. By definition t* is an optimal tax, but how can it be determined? Since it is equal to the MND at the optimum level of pollution, a "damage function" function is required to assess how pollution damage varies with the level of pollution emitted, and the monetary value of that damage. The fact that both the MNPB and MND functions are unknown and must be estimated should not be considered to be a

major flaw of the taxation option, but it will be shown later that significant errors of estimation and lack of information may give rise to serious inefficiencies. We now consider the taxation approach in a more formal framework.

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Biographical Sketch

Anthony David Owen BA, MA, PhD, FSS**.** Anthony Owen is currently Associate Professor of Economics at The University of New South Wales, where he has been employed since 1974. He was Director of the Centre for Applied Economic Research (CAER) from 1989 to 1995, and has been Director of the University's Energy Research Development and Information Centre (ERDIC) since 2000. He has almost 30 years of research experience in the fields of econometrics, energy economics, and environmental economics, and currently serves on the International Editorial Boards of *Energy Policy* and *Energy Economics*. He was Conference Chair for the 23rd Annual International Conference of the International Association for Energy Economics, held in Sydney, June 2000. He has had extensive consulting experience with the Organisation for Economic Co-operation and Development (OECD), and the Governments of Australia, Norway, and the United Kingdom. Professor Owen is the author of four

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