Economic Instruments for Pollution Control and Prevention – A Brief Overview

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More than two decades after environmental regulations were first introduced in the U.S., a new form of regulation promises to transform the pattern of pollution control. So-called “economic instruments”, which aim to control pollution by harnessing the power of market incentives, offer a more cost-effective, flexible and dynamic form of regulation than conventional measures.

The key benefit of economic (or fiscal) instruments is that they would allow a given pollution target to be met for lower overall cost than traditional regulations - a considerable advantage given the perceived high financial burden of regulatory compliance. There are other benefits too. Economic instruments grant firms and individuals greater autonomy in deciding how to meet targets; they create ongoing incentives for firms to design new and improved abatement technologies ensuring that pollution control becomes ever cheaper; they reduce the information burden on regulators; and they provide potential revenue sources for state or federal governments. In addition, economic instruments may provide greater flexibility in dealing with smaller and diffuse emissions sources which collectively contribute large amounts of pollution, but which until now have been largely ignored in favor of controlling the pollution from more obvious sources.

The use of economic instruments is becoming more widespread. Surveys show that about 100 economic instruments were in place in 14 OECD countries by 1987, rising to 150 by 1993 (OECD, 1997). In the U.S. they have been used most prominently to control SO_2 emissions under the Clean Air Act. As yet many applications of economic instruments are relatively small-scale in nature, and have often been introduced for the sole purpose of raising revenue. However, there is a growing familiarity and comfort with using such instruments which suggests more extensive and more large-scale use of such instruments is in the offing.

I. "Command and Control" Instruments: the traditional approach to environmental protection

In shaping the early environmental policies of the 1970s, policy-makers instituted standard-based systems in keeping with prevailing legal traditions of dealing with activities deemed excessive by society (Spence and Weitzman, 1994). This "command and control" pattern of regulation set uniform targets for how much firms should emit, often by dictating the processes that should be used in their facilities.

Two broad types of command and control regulations are discernible: technology-based and performance-based (Stavins and Whitehead, 1992). The former specify the methods and equipment that firms must use to meet the target.[1] Performance standards, on the other hand set an overall target for each firm, or plant, and give firms some discretion in how to meet the standard. Crucially, though, performance standards still hold firms to a uniform level across the industry, ignoring the possibility that some companies may be able to make reductions more readily than others.

In addition, early command and control regulations were often based on "end of pipe" solutions with little thought given to how pollution could be reduced through more systemic changes to the core production process or even in product design. Of course, changes at that level require the active input of manufacturers familiar with the industry. However, command and control regulations give the manufacturer little incentive to pursue such changes. There is no reward for beating a target, only the risk that the regulator will promptly raise the standard to reflect the new technology.

While command and control (or direct) regulations were successful in securing the first tranche of emissions reductions from previously unregulated industries, more than two decades after their introduction they are now viewed as increasingly burdensome. Industry bemoans the financial costs such regulations impose and the intrusiveness of a process which often dictates their technology choice. Regulators bear the burden of keeping abreast of technological developments in many different industries. Moreover, the process of ratcheting standards up over time often brings the two groups into antagonistic debate and involves lengthy and detailed discussion about the costs and suitability of alternative technologies upon which to base the next standard.

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1 Even where the standard is not couched in terms of exact technologies, they are often clearly premised on specific technologies which all firms end up using.

One final weakness of existing regulations is that they have focused on large point sources, both because these were obvious first targets, but also to minimise the information, monitoring and measurement burdens on regulators. Hence, large industrial plants have been forced to reduce effluents to waters and lakes, while the diffuse pollution from agricultural activities in the very same watersheds is largely unrestrained. In many cases, relatively cheap reduction efforts by farmers may yield the same environmental benefit as is presently achieved only at high cost through control of large point sources.

II. Economic Instruments: a better approach?

Economists have long advocated the use of economic instruments as an alternative, or supplement, to direct regulation. Most importantly, economists argue that economic instruments can create a system for pollution reduction that achieves the same level of environmental protection for a lower overall cost (or achieves more for the same cost). Given the importance of the overall costs of environmental protection in political debate, this is a crucial advantage. Economic instruments also allow for a more hands-off regulation and decentralized decision-making, giving greater freedom to firms and plants about how to comply.

Correcting a "Market Failure"

To understand the underlying logic of economic instruments, one must understand why pollution arises in the first place. Economists perceive pollution as a 'market failure' which arises because 'polluters' – from the heavy plants of popular imagination to people who turn on their lights at home – are not faced with the full consequences or implications of their production, consumption or disposal choices. In the classic textbook example, a manufacturer releases effluents into the nearby river, with adverse effects on fish populations. Downstream, commercial fishermen find their livelihoods under threat, recreational anglers start to find their weekend pastime less enjoyable, while others may simply be distressed by the loss of wildlife and the damage to ecosystems (e.g. Pearce and Turner, 1990). Because the use of the river as an effluent depository is perceived as free, the manufacturer has no incentive to curb effluents, in contrast to the permanent incentive he has to reduce labor, material, machinery and energy inputs, all of which have costs attached to them. In economic terms, the downstream impacts are 'externalities' that lie outside of the manufacturer's decision-making framework.

The underlying premise for economic instruments is to correct this market failure by placing a cost on the release of pollutants.[2] This will internalize the 'externalities' into the decision making process. Placing a charge, or a fee, on every unit of effluent released into the river, transforms the manufacturer's decisions regarding how much he will produce, and how he will produce it. Now, the manufacturer must minimize total production costs that consist not only of labor, material, machinery and energy inputs, but also of the effluent output. In some cases, the manufacturer may simply decide to invest in an "end-of-pipe" solution that pays for itself in terms of avoided effluent charges. In other cases, he may decide to alter the core production process, perhaps installing new technologies, or working with new materials which result in less waste. By adjusting the charge level, or the cost attached to effluent outputs, the regulator can induce a different degree of response from manufacturers, and hence control the overall level of pollution. By changing the charge level over time, the regulator has a relatively simple way of ratcheting up standards.

Several different types of economic instrument exist, all of which embody the same logic. (See Box). The most common alternative to a charge, and the preferred mechanism in the U.S., is the use of 'tradable permits'. Instead of an effluent charge, a manufacturer would be required to hold a permit to release a given quantity of pollution. Because these permits are tradable, the manufacturer can pay to get hold of more permits if he needs them, or he can sell his existing permits if he can work out a way to reduce his current pollution levels. By controlling the aggregate number of permits the regulator effectively controls the total release of pollution. Subsidies, both implicit and explicit, can also be used though are much less common.

In addition, economic instruments can be applied to certain products which cause pollution in their production, use or disposal. Such products include fuel, fertilisers, pesticides, batteries, and even, in Belgium, disposable cameras and razors (OECD, 1997). In some cases, the charge is part of a deposit-refund scheme which allows the user to redeem the initial payment if the product is returned to an appropriate waste channel.

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2 Hence, a technical definition for an economic instruments is a 'tool that affect estimates of the costs and benefits of alternative actions open to economic agents' (OECD, 1997).

A short taxonomy of Economic instruments

1. Charges, fees or taxes

These are prices paid for discharges of pollutants to the environment, based on the quantity and/or quality of the pollutant(s). To be most effective the charge is levied directly on the quantity of pollution ('emissions tax or charge'), though if this is difficult to measure or monitor, it may be necessary to levy a charge on a proxy for the emissions, typically on the resource that causes the pollution ('product tax or charge'). Product charges occur at different usage points. They have been levied on products either as they are manufactured (e.g. fertilizers), consumed (e.g. pesticides) or disposed of (e.g. batteries) (Barde, 1997).

How effective product charges are depends on how well 'linked' the input, or product, is to the eventual stream of pollution. In the case of taxing carbon fuels as a proxy for carbon dioxide emissions, the 'linkage' is very strong as virtually all the carbon contained in fuels is released during combustion. Taxing the fuel is thus little different to taxing the emissions. On the other hand, taxing pesticides as a proxy for release of certain chemicals into water systems is less well linked as the degree of chemical infiltration will depend on a mixture of variables relating to soil and slope conditions, the timing of applications etc.

2. Tradable Permits

These are similar to charges and taxes except that they operate by fixing an aggregate quantity of emissions rather than charging a price for each unit of emissions. Instead of being charged for releases, one needs to hold a 'permit' to emit or discharge. By controlling the total number of permits, one is effectively controlling the aggregate pollution quantity.

3. Charge-Permit Hybrids

It is possible to blend the quantity-based permit approach with a price-based charge or tax approach to try to harness their different strengths while avoiding their weaknesses. A good example is RFF's proposal to use a hybrid mechanism to control CO_2 emissions in the U.S. (RFF, 1998). This would consist primarily of a permit program that would require domestic energy producers (and importers) to obtain permits equivalent to the volume of carbon dioxide eventually released by the fuels they sell. However, by setting the overall permit quantity, one has no idea what price permits will sell for – this will only be revealed as businesses and consumers begin to reduce their CO_2 emissions. In order to guard against excessively high permit prices that might arise – the very prospect of which may prevent the program being implemented in the first place – the second aspect of the proposal would be for the government to release an unlimited number of permits at $25 per ton of carbon should the market price of permits reach that level. This effectively sets up a charge system of $25 per ton, capping the possible market price.

A system like this attempts to control on the basis of quantity, which is the most desirable goal, while creating an 'escape valve' should costs rise too high. Even if the escape valve is utilised, the program amounts to the institution of a charge on carbon.

4. Deposit-refund schemes

Under these schemes, a surcharge is levied on a product at the point of payment. When pollution is avoided by returning the product, or its polluting components, to a specified collection stream the surcharge is refunded. These economic instruments have been used most often for drinks containers, batteries and packaging (OECD, 1997).

5. **Subsidies**

Where taxes or charges can be used as a penalty on discharges, subsidies can be used to reward the reduction of discharges in a similar manner. The financial incentive is effectively the same, though the flow of funds is in a different direction. A subsidy program will involve a transfer of funds from the government to the industry, while a charge program would be a revenue source for the government.

Subsidies may be relatively explicit in the form of grants and soft loans, or be somewhat indirect, such as in adjusted depreciation schedules. (Barde, 1997).

Three Key Advantages

Economists have championed economic instruments mainly on the grounds of three key advantages that they hold over traditional forms of regulation:

1. Static efficiency (or "cheaper now"). One of the crucial properties of economic instruments is that firms not only take different actions, but may also end up with different levels of emissions. Firms that find it relatively cheap to undertake reductions do more than firms that find it more expensive, ensuring that the *overall* cost of reduction is less expensive than if all firms were required to meet a uniform standard.

In practice, manufacturing plants are far from uniform. Even if they are making the same product, they will tend to operate different technologies, use slightly different processes, and will vary with respect to size, scale, age and hence, overall efficiency. All of these factors will ensure that the costs of meeting the standard are very different for different companies. For one firm the costs to make an extra unit of reduction may be quite high. In contrast, another firm may be able to make an extra unit of reduction (and more) for a relatively low cost. Rather than require the same standard from both of them, the *overall* cost of making reductions will be lowest if the latter firm takes advantage of the cheaper reductions it faces. The impact on the environment will be no different, but the *aggregate* cost of the regulation will be reduced. This outcome can be readily achieved with an economic instrument.[3]

On the face of it, this might not seem fair – companies make reductions on the basis of their ability to do so, not on the basis of how much better or worse they are relative to competitors. This is in contrast to a rule-based approach where certain forms of behavior are expected from everyone. Importantly, though, both are suitably rewarded or penalized for their efforts. The first firm may continue to emit more pollution but pays a price for doing so. The second firm undertakes further control and reaps a lower tax bill, and competitive advantage, for doing so.

An economic instrument can achieve a given level of environmental protection for lowest overall cost by creating a framework that allows for differential response by companies depending on their ability to make reductions. In contrast, target- or performance-based command and control regulation is less efficient because it ignores the fact that some plants can make reductions more cheaply than others. To control the overall level of pollution, the regulator simply adjusts the level of the charge (or the quantity of permits).

2. Dynamic Efficiency (or "cheaper in the future"). Under a command and control approach, industries invest to meet the standard and then stop. In contrast, placing a price on effluents creates a permanent incentive for environmental improvement. Because every emission, or effluent, effectively has a price attached to it, any profit-maximizing entity has an ongoing incentive to make further reductions over time. Engineers and designers have a permanent incentive to generate new processes or equipment, to develop new product designs, to create new abatement methods and to reconfigure existing production lines to reduce the outflow of the targeted pollutants. An economic instrument creates a permanent incentive for environmental improvement and should accelerate the development of new and cheaper pollution reducing technologies

3 Technically, this outcome could also be achieved through direct regulations were the regulator able to work out the differential reductions required from each firm that would lead to the target being met at lowest possible aggregate cost. However, that would require that the regulator have full information about the costs of making reductions at each and every plant. In contrast, the economic instrument arrives automatically at the same differential reduction levels simply by setting a given charge level (or permit quantity).

3. Revenue Raising. Finally, the use of many economic instruments allows the state or federal regulatory agency to raise money. A charge, for example, raises funds that can either be used to finance environmental clean-ups, or to replace existing taxes. The same is true if permits are initially allocated through an auction.

Alternatively, the regulator may forego the opportunity to raise revenue and instead grant a valuable property right directly to the groups being regulated – a potential fillip that eases the regulatory process.

Distributional Consequences of Economic Instruments

This third advantage touches on the distribution issue of new instruments. The introduction of an economic instrument transforms the government's presumed right to set standards into an instrument that induces monetary flows from one party to another. Different forms of economic instruments imply very different property rights for different parties. This can be seen clearly by comparing an emissions charge with an equivalent subsidy program.

Consider the case where a manufacturer confronts a charge of $10 per unit of emissions. Any reduction made saves the manufacturer $10 per unit which would otherwise have been paid to the regulator. Under an equivalent subsidy, the regulator pays the polluter $10 to reduce each unit of emissions. Either way, the manufacturer's incentive to reduce the emission is the same as it leaves him $10 better off (and the regulator $10 worse off). However, the baseline and the established property rights are very different as are the overall financial implications of the program from the company and regulatory perspectives. The use of a charge implies that the manufacturer has no 'right' to pollute, and instead that the right has to be 'bought'. In contrast, the subsidy institutes a 'right' to pollute at current levels and leaves the government or regulator to 'buy' any reductions below that level.

Exactly the same issue is raised in deciding the initial allocation of tradable permits. These may be auctioned to companies (equivalent to the tax case) or "grand-fathered" to companies on the basis of their existing emissions (equivalent to the subsidy case).

It is important to bear in mind that for every property rights winner, there is a loser who might otherwise have been the beneficiary. Hence, while grandfathering permits may be useful in dampening industry opposition to new regulations, grandfathering foregoes any revenue that the government might have raised by auctioning the permits. This revenue would allow either additional spending programs, or more likely, a reduction of existing taxes creating benefits for different groups of the public depending on the exact use of the funds.

A Carbon Tax or a Tax Shift

One potential application of economic instruments deserves particular mention. Many groups have proposed a 'carbon tax' to reduce the carbon dioxide emissions that come from fossil fuels and which threaten to change the climate. A carbon tax would essentially be a product charge placed on fossil fuels in proportion to their carbon content. Coal which has a higher carbon content than oil and natural gas would thus be taxed relatively more. The rising prices of these fossil fuels would induce people to use oil and gas in favor of coal; to use more renewables instead of fossil fuels; and to be more efficient in their use of energy generally. Applying such a tax would ensure that the economy as a whole achieved a given level of carbon dioxide reduction for the lowest overall cost.

Because of the scale of fossil fuel use in the economy, any carbon tax could raise significant amounts of revenue, which could be used to a make a significant reduction in an existing federal tax. (Taxes on labor and/or capital are most often cited as possible candidates for a reduction). In the same way that placing a tax on carbon reduces its presence, reducing a tax on, say, labor, would tend to increase employment. Hence, a 'tax shift' would increase taxes on 'bads' (i.e. carbon) while we wish to discourage, while reducing the tax on 'goods ' (e.g. employment or investment), which we desire more of.

Small carbon taxes are already in place in some European countries. However, efforts to promote the idea at EU level and in some U.S. states, most notably Minnesota, have so far been unsuccessful.

III. Conclusions

The use of economic instruments would allow additional environmental improvements to be met at least cost, or would allow present standards to be met more cost-effectively. As a regulatory mechanism they are more in keeping with the prevailing market structure that automatically promotes efficient solutions and that encourages and rewards innovation. Though economic instruments have been in the textbooks for as long as conventional regulations have been in the statute books, their use to date has been confined to relatively few applications. As their advantages become more widely understood, and as the desire grows to balance benefits and costs of environmental protection, it is likely that their use will increase in coming decades. In practice, with a well established regulatory system based on traditional measures already in place, the key issue will be to work out how economic instruments can complement, and integrate with, conventional measures.

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