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Comparative economic characteristics of environmental protection tools

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Abstract. The relative advantages of the tools for the environmental protection have been assessed in the article. From the economical point of view emission taxes, subsidies for abatement of emissions, and market-based permit system are more preferable in comparison with the control and management systems. The control of emissions for each organization can be achieved only in case when the marginal costs of abatement for each pollutant are known, which is unlikely in practice. In case of immiscible pollution, the determination of the marginal costs of organizations to control emissions is not required only for permitting schemes, which gives them an advantage over other tools. The least expensive for achieving a particular purpose in the fight against pollution is the tool of minimum technological requirements for the protection of the environment. The long-term effect of the instrument depends on the net income effect and the effect of technological innovation. Subsidy schemes or alternative methods of initial distribution of market permits at the expense of positive effects of income can increase the size of the industry, which is undesirable from the ecological point of view. In order to neutralize this effect, the organizations of the subsidized industry may be obliged to make one-time payments, the amount of which is the total cost of subsidies. The second way is the induced impact on the pace of technological innovation. Control and management tools have weak incentives for innovation. An emissions tax (or emission control subsidy) will encourage environmentally sound innovation. In the market scheme, emission reductions reduce taxes. Pollution control instruments have different consequences for the distribution of income in the economy and the competitiveness of the economy.

1. Introduction

The development of mechanisms for environmental management, consisting of a system of tools for rational, environmentally sound management [1] is an urgent problem of the resource use and environmental protection. In practice, many tools designed to achieve various objectives in the field of environmental protection are used now. Instruments have different effects on income distribution, they have different incentive structures to reduce pollution, and different expenses on environmental protection measures [1-8].

2. Results and discussions

We will assess the relative merits of alternative pollution control instruments. From the economical point of view, it should be noted that taxes on emissions, subsidies for controlling emissions and market-based permit system can achieve any emissions rate at least from the point of view of costs. A regulatory instrument for the control and management system may be, but usually will not be cost-effective. The state organization for environmental protection should take into account the marginal expenses for abatement of emissions for each pollutant in order to be able to control emissions for each organization that equalizes the marginal expenses of abatement with the industry-wide value. It is highly unlikely that this requirement will be met. The conclusion that can be drawn from this is that the management and control quantitative approach is not effective in relation to the system of taxation, subsidies and commodity permits and will thus achieve the goal at higher real costs.

We will consider some empirical data on abatement costs using command-control and market-based tools. There is now a vast literature on the comparative evaluation of the cost of achieving the goal of reducing emissions using traditional quantitative and technological rules – what applies to monitoring and management tools and so-called market tools (particularly emissions taxes, subsidies and market of emission permits). Much of this literature analyzes the experience in the US with these two categories of tools. So the study of Tietenberg (Tietenberg) (1990) allowed us to determine these costs. Table 1 shows the cost ratio to least-cost control measures (using market-based instruments) for air pollution control in the United States [2].

For immiscible contaminants, the above conclusions should be clarified. Cost-effective control and management systems involve determining the marginal costs of organizations to abatement of emissions. But in this case, the same applies to tax and subsidy tools. As a rule, such information is not required only for authorization schemes. This leads to a large potential advantage of permits system over other tools.

The use of each environmental protection instrument is associated with the costs required for monitoring, management and other activities. These costs can be substantial. If they are high and if they differ significantly among instruments, then these costs are likely to be important for what type of instrument is the least costly to achieve a certain objective. One of the reasons for the prevalence of minimum technology requirements as a tool for pollution control may be the fact that these costs are low in comparison with the cost of tools that is supposed to regulate emission levels.

As for long-term effects, it should be noted that from the point of view of the State organization for environmental protection, the choice of tool will depend on the extent to which the scope of pollution control changes over time for any particular instrument. An important finding will be how much the long-term effect differs from the short-term effect. The long-term effect of the instrument depends mainly on two factors: the net income effect and the effect of technological innovations.

Table 1. Empirical research on air pollution control.

Research	Pollutants	Geographical areas	Control and management standards	Cost ratio with the lowest cost
(Atkinson and Lewis)	Particles	Сент-Луис	SIP rules	6,00[a]
(Roach et al.)	Sulphur dioxide	Four places in Utah	SIP rules Colorado, Arizona and new Mexico	4,25
(Hahn and Noll)	Sulphate standards	Los Angeles	Radiation in California	1,07
(Krupnick)	Nitrogen dioxide norms	Baltimore	Proposed byRACT	5,96[b]
(Seskin et al.)	Nitrogen dioxide norms	Chicago	Proposed byRACT	14,40[b]
(McGartland)	Particulates	Baltimore	SIP rules	4,18

(Spofford)	Sulphur dioxide	Lower Delaware Valley	Unified Interest rates	1,78
(Spofford)	Particulates	Lower Delaware Valley	Lower Delaware Valley	22,0
(Harrison)	Airport noise	USA	Compulsory upgrading	1,72[c]
(Maloney and Yandle)	Hydrocarbon	All DuPont plants	Equitable percentage reduction	4,15[d]
(Palmer et al.)	Freon emissions as a result of not aerosol application	USA	Proposed standard	1,96

Notes: SIP = State Implementation Plan; RACT = Reasonably Available Control Technologies, a set of standards imposed on existing sources in inaccessible areas;
[a] Based on 40 µg/m3 at worst of receptors;
[b] Based on the short-term period of time, an average of 250 µg/m3 per hour;
[c] Since this research is "benefits–costs" not "cost-effectiveness", the comparison of Harrison with the approach of "control and management" with the lowest cost implies different levels of benefits. In particular, the levels of benefits related to the distribution of the lowest costs, make up only 82% of the levels associated with distribution in monitoring and control system. In order to estimate costs based on more comparable benefits, the first approximation was to divide the lowest cost distribution by 0.82, and the resulting number was compared with the cost of the control and management system;
[d] Based on 85% reduction of emissions from all sources;
Source: Tietenberg (1990), table 1 [2]

Changes in the net income due to the operation of the pollution control tool may affect the size of the industry in the long term. Subsidy schemes may have the undesirable (from the point of view of environmental problems) feature of increasing the size of the industry in the long term due to the positive effects of income. Similar questions arise when comparing alternative methods of initial distribution of market permits.

In principle, control ways that are neutral to income can be developed. Thus, the organizations of the subsidized industry may be obliged to make one-time payments, the amount of which is the total cost of subsidies. This will maintain to preserve the incentive effect of subsidy schemes, avoiding the long-term effects of income changes. However, the implementation of such a scheme may be politically difficult and there may be reasons why the government will not be able to compare the income and payments.

The second way in which long-term effects can be transmitted is the induced impact on the pace of technological innovation. It is important to consider two aspects here. One is the so-called dynamic performance results. They derive from the structure of incentives for innovation created by pollution abatement tools.

A common argument in this regard is that control and management tools are characterized by unsatisfactory features in the long run, as they have weak incentives for Jaffe and Stavins Innovation (Jaffe and Stavins) (1994). The binary nature of many of these tools (whether the goal is achieved or not) creates a prerequisite for change in the activities of organizations: once the desired goal has been achieved, there is no longer any incentive to move on.

In contrast, an emissions tax (or abatement of emmisions subsidy) would generate a dynamically effective model of incentives for corporate (and consumer) behaviour. The structure of incentives constantly encourage successful environmentally friendly innovation. In a market scheme, every unit of emission reduction is rewarded by a tax saving.

The key question here is what incentives organizations face in developing environmentally sound technologies or new environmentally sound products. According to the emissions tax, these incentives can be strong, as shown in figure 1.

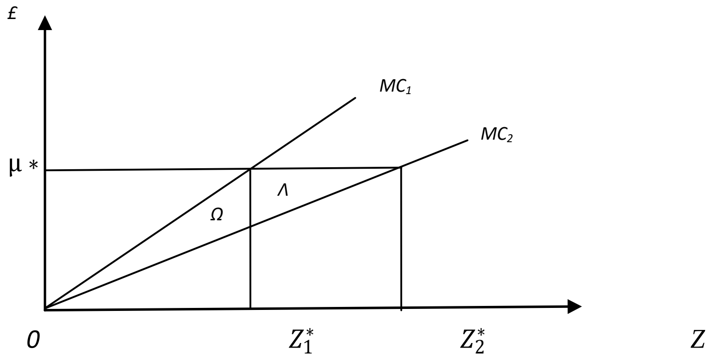

Figure 1. Dynamic incentives under emissions tax controls.

The ω region is the savings that could arise if the marginal cost is reduced from MC1 to MS2 and the emission level is constant. But if marginal costs were reduced in this way, the profit-maximizing level of the organization's emission reductions would increase from Z1* to Z2*, and thus the organization would gain additional savings Λ.

The organization has an incentive to develop new technologies to reduce emissions if the total cost of development and application of the technology is less than the current value of savings Ω+Λ obtained by the organization for the entire period of its operation. (It should be noted that the situation is actually a little more complicated, because the optimal tax rate will change as the cost of pollution control is reduced with the use of new technology).

In contrast, dynamic incentives are weaker or absent in the control and management system. As noted above, if the target is set in (non-market) quantitative terms, there will be little incentive for the pollutant to reduce emissions once the target is reached.

But there is a second aspect that weakens the strength of these arguments. Some researchers believe that technological change can be controlled from above. Suppose that the State organization for environmental protection determines the best environmentally sound technology and sets it as a requirement for organizations based on minimum acceptable technological standards.

Not only this will have a direct impact on technology diffusion, but it can also have a powerful indirect impact. Barriers due to contradictions, lack of information and other market failures that may lead to organizations being overly cautious or unable to act voluntarily will no longer be insurmountable compared with the requirements of the state organization for environmental protecti

In addition, these changes have catalytic effects that stimulate innovation as cognition effects emerge. Such arguments are likely to be most relevant to technological innovation and are characteristic of a developing economy.

Based on the above reasoning, it is difficult to draw unambiguous conclusions. Nevertheless, it can be concluded that in some circumstances, technological control and other management tools will have more preferable features in the long term compared with market tools.

The effects of pollution control policies on distribution will be very important in determining which tools will be selected in practice. Different pollution control tools have different effects on distribution system in economics.

In particular, the emissions tax levied on fossil fuels has different effects on the distribution of income and wealth in society. It indirectly affects end-users who buy goods with high energy consumption. Persons for whom heating is a significant part of their budget may well face a fairly large drop in real income. Indeed, many green taxes can have a regressive effect on income distribution.

It should be emphasized that there is a difference between income changes, which are only redistributive and do not correspond to any real growth and losses of resources for the economy, and changes in real incomes, which imply changes in real resources for the economy in general.

The latter arise because pollution control has real expenses. Obviously, with less pollution, there are advantages that within a well-designed pollution control programme should outweigh these real expenses. However, the beneficiaries and those, who incurred costs will not be the same persons, and this is the subject of discussion in assessing the fairness and objectivity of the instrument.

It should also be noted that emissions taxes (and other environmental control measures) have important implications for the relative competitiveness of the national economy. Some analysts: Bertram et al. (2001).) (1989), brown (Brown) (1989), Grubb (Grubb) (1989a), Hansen (Hansen) (1990), Kosmo (Kosmo) (1989) and weizsäcker (Weizsäcker) (1989); advocated a shift from taxes on labour and capital to taxes on emissions in order to avoid an excessive tax burden, and proposed schemes of penalizing countries that are trying to gain a competitive advantage without introducing taxes on emissions [3, C. 237-238].

The government may use compensatory fiscal changes to avoid systematic changes in the distribution of income and wealth among individuals if a particular instrument has a negative financial impact on a particular sector of the economy,

For example, financial transfers implied by the emission tax system can be reimbursed to organizations by one-time payments or emission control subsidies. Income transfers to poorer groups facing higher energy bills, for example, can be reimbursed by other tax changes.

The point here is that the additional tax revenues received by the government can be distributed among groups that have been adversely affected by the change in environmental policy. However, there are great difficulties in designing such activities. In cases where compensation is paid to individuals or groups of individuals for whom the tax burden is considered excessive, the form of compensation should be designed in such a way as not to alter their behaviour, otherwise it will adversely affect the effectiveness of the tool. This means that it is preferable to use one-time compensation, which is rarely implemented in practice.

3. Summary

Emission taxes, abatement of emission subsidies and the market permitting system are the most cost-effective in case of immiscible pollution, only permit schemes will be effective. The least expensive for achieving a particular purpose in the fight against pollution are the minimum technological requirements for the protection of the environment. One-time payments and pace regulation of technological innovations can be used to neutralize the positive effects of income and to increase the size of the industry.

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