Eco-taxes -- A note

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Any kind of economic activity generates several types of pressures on the environment. Broadly these pressures can be classified into three categories: a) input demands (e.g., materials, energy, intermediate products); b) pollution/ waste flows; and c) ecosystem modifications (e.g., by spatial claims for roads or dams or inter-linking of rivers etc.). These pressures are normally buffered by absorptive capacity - i.e., ability to assimilate waste, absorb pollution, resilience of ecosystem to disturbance, etc. - and regenerative processes in the environment. If these pressures exceed the buffering capacities, it leads to environmental change; if the change leads to a reduced capacity of the environment to satisfy the human needs, then one can speak of the environmental degradation. This degradation may lead to policy responses in terms of measures aimed either at reducing environmental pressure or enhancing environmental buffering capacities.

Environmental policy uses a range of instruments that induces behavioural change of economic agents so as to actualise these objectives. Taxes on inputs or outputs - also known as Eco-taxes is one such instrument that can signal the costs of using the environmental resources and thus internalises the negative externalities in decision making by producers and consumers. An Eco-tax is a price-like instrument, which assigns a price to the 'unpaid factor' of production, thus translating the polluter pays principle in practice.

Though eco-tax is a policy instrument that attempts to internalise the negative externality, it is quite possible that the existing tax policies may itself encourage inefficient use of environment resources as is evident from the following examples. For instance, investment tax credits in Brazil encouraged exploitation of environmentally weak areas. Similarly, in Haiti, a raised export tax on coffee caused coffee trees to be replaced with staple crops such as corn. This led to increase in erosion of steep lands. In a similar vein, income tax exemptions also impact environmental management. Since in a number of countries including India, agricultural income is exempt from income tax, this has resulted in increase demand for land and thus contributing to a rapid increase in the conversion of forest to agriculture uses.

Types of Eco-taxes

In general a number of ways i.e., eco-tax schemes exist through which one can internalise the externality. These include input taxes, output or product taxes, export taxes, import tariffs, tax differentiation, royalties and resource taxes, land-use taxes and investment tax credits. For

example, tax differentiation involves a positive charge being levied on a polluting product and a negative charge, or subsidy, on a cleaner alternative. The most common example of this tax differential is in the context of transport so to discourage consumer purchases of polluting vehicles or fuels. Less tax on compressed natural gas (CNG) vis-à-vis petrol in Delhi is one such example. Differential taxation of leaded and unleaded gasoline across the Europe and some of the developing countries is another example. In the Netherlands, for example, unleaded gasoline is taxed at 0.1 ECU per 100 litres (i.e., about US $0.004 per gallon) and leaded gasoline at 1.74 ECU per 100 litres (i.e., about US $0.08 per gallon in 1989).

Taxes on polluting inputs are generally suggested when there is a clear linkage between input use and environmental damages. An interesting example of the above tax is 'forestry tax' charged in Brazil, Colombia and Venezuela for wood consumption if there is no reforestation activity. A nice and promising feature of such taxes is that it alleviates the need for (costly) monitoring. However, it needs to be noted that taxes on polluting inputs generally do not yield equimarginal abatement costs. Since one of the benefits of economic instruments (EIs) often cited in the literature is their cost effectiveness, as they equate marginal abatement costs across individuals. This implies input taxes are not always cost-effective.

The most important application of input taxes can be in non-point source of pollution (NPSP) setting such as taxes on fertilisers in agriculture so as to reduce nutrient loading of water-bodies or taxes on gasoline to reduce vehicular pollution. However, a high tax on either may have high undesirable distributional consequences. This is because a high tax on fertilisers tends to penalise grain farmers with generally lower nutrient leakage. Thus, it is not the least-costly policy option. However, in this case by combining percent nitrogen tax with a certain percent of catch crop requirement may yield the desired reductions in nitrogen leakage, as has been done in the Netherlands.

The choice of taxing an input or output is not arbitrary. The suitable option depends on the pollutant in question. This can be easily demonstrated using CO2 and SO2 as an illustration. Figure 1 gives the six possible policy states (including the state of no control) and the six possible moves between states to control a pollutant.

The current policy could be either no control (e.g., on fertilisers or pesticides), or some technology standards (e.g., mandatory use of catalytic converters) or some emission standards (e.g., EURO II norms for cars). The move to control pollution will be from current policy to input/output/ emission taxes. The taxes levied can be at optimal or at sub/non-optimal rates. The

sub-optimal taxes are not by choice, but due to the near impossibility of valuing the future environmental damage caused by the pollutant. The Love Canal in US where the impact of dumping toxic waste got detected only after two decades when the dumping had already ceased is a clear reflection of difficulties in valuing the environmental damages. On the other hand, optimal tax rates mean that the damage is adequately assessed and the pollution is optimally controlled, or in other words, the environment receives the 'right' amount of help.

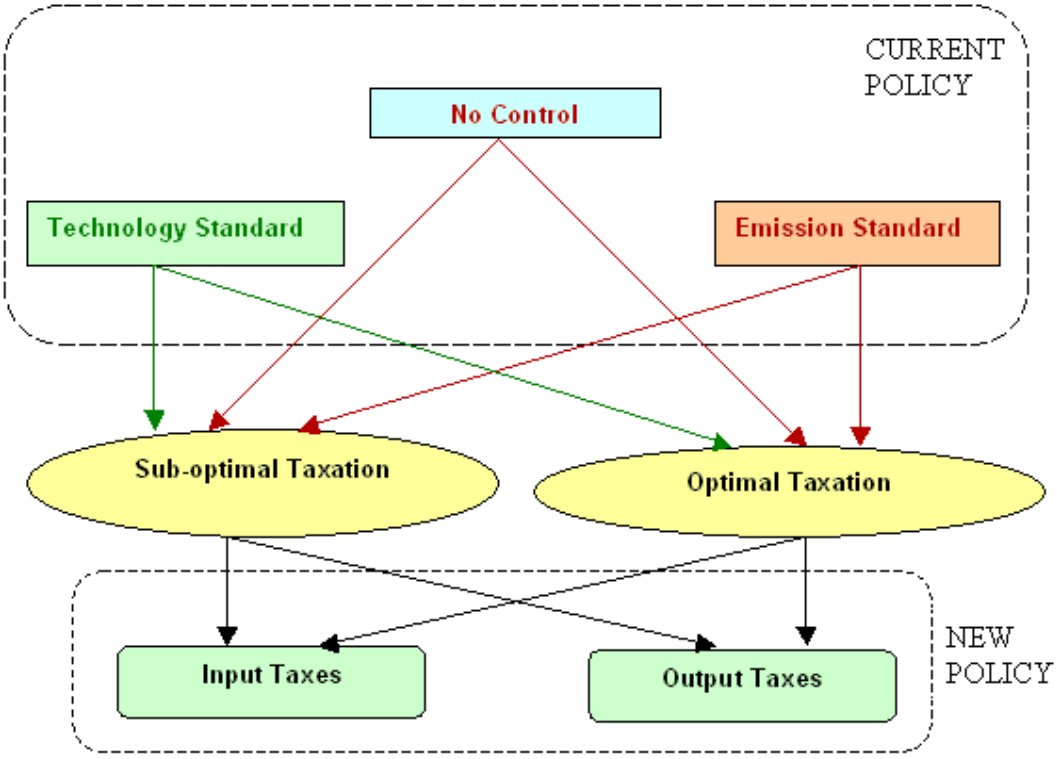

Figure 1: Possible Options from No-control or CAC to Eco-taxes

Criteria for selecting a policy option - with CO2 as an illustration

Crudely speaking, there are four criteria that dictates the move from current policy to eco-taxation. However, the application of these criteria depends on the pollutant in question. First, it must be known that emissions cause environmental damage. In the case of SO2 and CO2, the local damage caused by SO2 has been known for decades, though its long distance damage in the form of acid-rain / deposition is fairly recent. On the other hand, the impact of CO2 on climate change is still controversial. Second the emissions must be controllable. In terms of control of emissions, pollutants can be classified into two broad types: type 1 are those that are an unwanted

byproduct of a production process, and type 2, where the marketed output of a production process is or becomes a pollutant. Traditional pollutants like SO2, particulate matters etc. fall in the former category. However, CO2 from fossil fuels, Chlorofluorocarbons (CFCs) etc. are in the second group. For pollutants of type 2, there is no control technology, and the goal of the environmental policy must be to reduce or eliminate the usage of the product. Incidentally, in the case of CFCs this has been achieved in the developed world as well as in India, but in the case of fossil fuels, no alternatives are available immediately, at least on a sufficiently large scale. However, technologies to control pollutants of type 1 are commercially available such as tall stacks to disperse and dilute the emissions or flue gas sulphurisation to reduce total emissions.

The third criteria is that it must be affordable for the government or agency to monitor the results of its policy; whereas the fourth and the last criteria is that there must be 'political will' to impose the costs of control on polluting firms (and their customers). At the moment, there exist huge differences in monitoring costs between SO2 and CO2 as shown below in Table 1:

	Proportion (%) of total emissions coming from	
Pollutant	Non-point sources(Housing, Commerce, Transport and agriculture)	Point Sources(Power stations, refineries and other industry)
SO2	11	89
CO2	44	56

Source: Park and Pezzey (1999: 168) (Original Source: UK. Dept. of Trade and Industry (1996), Digest of UK Energy Statistics, pp. 190-91).

Since 44% of CO2 emissions come from small and often mobile emitters i.e., NPSPs, it makes it prohibitively expensive to monitor a large majority of individual emissions. Moreover, beyond a threshold it is extremely difficult to increase the energy efficiency of most existing equipment, it clearly reflects in little political will to set efficiency standards for existing CO2 technologies. The CO2 efficiency standards thus apply to only new equipments. Even if technologically it is possible to reduce CO2 emissions, they hardly give any incentive to find alternative means of control and provide no direct control over the level of emissions. This implies it is preferable to have emission standards than the technology standards. Emission standards should ideally be set in terms of the total emissions from a site or industrial estate or region, often known as 'bubble' policy in the US, rather than in terms of emissions from one stack or emissions concentrations.

The equivalent indirect move for CO2 would be to move from setting standards to fixing the amount of carbon energy actually sold (since CO2 emissions are directly in proportion of this), which is rather incredibly costly. But this paves the idea of moving from (indirect) technology standards for CO2 to control it by a tax called as Carbon tax. A Carbon tax will create a pervasive incentive to reduce CO2 emissions in the most cost-effective way, without specifying which users are to reduce emissions, by how much, or with which technologies. Since direct monitoring of CO2 emissions is very costly and as almost all carbon fuel used is burned, the tax incentive is applied to carbon inputs instead.

Definition of Effectiveness

Taxes might be called effective if they do what they are intended to do. In theory, environmental taxation should attempt to improve the market efficiency of the environmental goods and services by imposing a price on such goods equal to the marginal costs of their use (i.e., the marginal environmental damage costs). If policy makers can calculate these costs, environmental taxation is inherently effective, provided no other major imperfections distort the relevant markets. However, finding the marginal environmental damage costs is rather difficult. The UK landfill tax introduced in 1996 is considered to be the only example, which is explicitly based on an estimate of these costs

The environmental taxes can have different functions: a) cost covering; b) incentive effects; and c) revenue raising. In order to assess the effect of taxes, two criteria are generally used that also encompasses these functions. These are:

1. Environmental Effect - The effect of the tax on environmental pollution or the use of scarce resources;

2. Incentive Effect - A comparison of the tax rate with the marginal pollution abatement costs, or as a proxy, average abatement costs of measure taken by the polluters.

Together they indicate the 'overall effectiveness'. Both the criteria however, can be used to assess a similar impact in different ways. The first criterion directly attempts to trace the contribution of the tax to the monitored pollution reduction, while the second criterion endeavours to establish incentives for taxpayers to change their behaviour in a way more favourable to the environment by adopting suitable measures or by saving on scarce resources.

The main function of fiscal or revenue raising environmental taxes is raising income for government expenditures. Environmental effects are a side-effect. However, positive environmental impact may be expected because of the price effect on behaviour. Consequently, evaluating the environmental effectiveness of this type of tax involves examining the environmental effects, e.g., in terms of pollution reduction. Similarly, incentive taxes are designed to achieve a specific environmental impact. So the evaluation of environmental effectiveness includes comparing pollution reduction targets. It also involves measuring the incentive effect by comparing the differential between the tax rate and the cost of pollution reduction.

On the other hand, cost-covering charges are designed primarily to raise funds for financing specific environmental systems, measures or programs. Two types of cost-covering charges are - (a) user charge; and (b) earmarked charge. In both cases, funds raised form the major objective, so effectiveness evaluation involves assessing the money available for carrying out the environmental measures or programs. However, the cost-covering charges may also have an incentive impact if charge rates for cost-recovery reach substantial levels e.g., in the case of Dutch water pollution charge. Incentive effects are sometimes aimed for cases where formerly fixed rates for certain environmental services were differentiated according to the level of the service rendered. Variable charge rates for household garbage collection in the form of 'pay-per-bag' scheme or 'effluent treatment charges' based on the quantity and/or quality of effluent are two such examples where rates are differentiated according to the services rendered.

Effectiveness of Taxes/charges - Evidence

As mentioned, the effectiveness of charges / taxes can be assessed based on environmental effectiveness and incentive effectiveness, the following tables 2 and 3 give the effect for a number of taxes implemented in a number of countries.

The above tables indicate that at some places actual environmental effectiveness of green taxes could not be ascertained due to non-availability of ex-post policy evaluation studies. OECD in a study has concluded that there is little tradition in ex-post policy evaluation. A practical reason for non-evaluation studies is the complexity. These studies have to cope up with difficult methodological problems as well as the problems of data availability. Both these problems

however can be minimised if the evaluation is built into the process of designing and implementing stage itself. The OECD has considered this question in somewhat deep. Following table summarises some of the information and design features that will facilitate improve future evaluation studies.

Stage	**Policy Process**			
1	Identifying and defining the environmental problem			
2	Discussing the need for policy intervention and setting objectives	Link	Stage	Evaluation Procedure
3	Designing and assessing effective and efficient options (instruments or instrument mix)		1	Description of the instruments and of the institutional context, definition of relevant internal and external factors (baseline inventory)
4	Selecting, discussing and adapting instrument chosen		2	Definition of evaluation criteria
			3	Construction of evaluation model and definition of all data to be gathered
5	Introduction of instrument (mix), implementation of control and enforcement		4	Continuous collection of data and reassessment of influential factor and ex post evaluation
			5	Possible adaptation of the evaluation model, evaluation criteria and data
6	Possible modification of instrument (mix) after evaluation		6	Conclusions, recommendations and feedback into the policy process

The above discussion indicates that taxes on inputs or outputs are second-best, and are frequently applied on the energy source or chemical that is generating the pollution. Ideally the pollution charge should be imposed on the emissions. But in practice, this is rather impossible. Taxing the source of the pollution rather than the pollution itself does not allow for (a) the possibility that mitigation measures can be undertaken at the 'end of the pipe'; and (b) the fact that the impacts in terms of damages vary spatially, so that a general tax overtaxes use in a place where there is no environmental problem, and undertaxes it in places where the problem is very serious. The first issue can be tackled rather easily by giving rebates for payments when the polluter makes such an investment in an end-of-pipe clean-up. For examples, giving a rebate on sulphur content tax for polluters who have flue gas desulphurisation equipment.

However, the problem of spatial variation is difficult to address. The problem can be circumvented if we have different rates of taxation depending upon where the inputs are used, which is practically difficult to implement even at a crude level. Moreover if input or output taxes are varied across regions, this would result in trade leakages between regions (provided the input or output permit prices exceed the transport costs between regions), which would dilute the impact. Still the other big advantage of using taxes on polluting inputs and outputs is that they can be a major source of revenue, which can generate resources for environmental protection, and even facilitate shifting the structure of taxation away from taxing 'goods' such as consumption and employment to taxing 'bads' such as pollution.

To conclude, the case for using input/output taxes (or charges) as an economic instrument for environmental protection, and as part of the programme to move to sustainable development, is strong but requires qualification. For a number of applications such as NPSPs, taxes on inputs are the only way to deal with the issue. This however, does not solve the problem of 'hot spots' or local concentrations of pollutant, for which direct controls of some kind are mandatory. Thus an optimal mix of policy instruments is going to be one that combines economic instruments with direct controls. Another argument in favour of input/output taxes is that they are easier to collect. Since emission charges can be extremely difficult to collect and spatial variation may be impossible for them, the case for moving to input taxes/charges gets further support. Lastly, eco-taxes can be a part of a broader tax reform so as to set the markets right.

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