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Economic management of the environment

Peter Barker

SOURCES OF POLLUTION AND DEGRADATION

Increasingly the developing world has to face the twin problems of degradation and pollution of the natural environment. The latter is taken to be the natural assets of the air, soil, water, mineral, scenic, flora and fauna resources. Other resources are capital, labour and entrepreneurial assets. Like these latter named assets, environmental resources may be used up in the economic process and depleted or degraded over time. Because populations of developing countries are often more immediately dependent on the natural environment, not least for agriculture and water, it is agruable that their representatives should be especially cognisant of the need to manage the environment in an economically sustainable way (ref. 1). Currently there is much debate about the means by which sustainability may be achieved. Some insights into possible control mechanisms can be obtained from identifying the factors that lead to environmental degradation and pollution.

Pollution and degradation are closely related concepts in that in each case the root causes are that natural assets are characterised by rivalry and non-exclusiveness. The former means that one person's consumption of an asset subtracts from the total available for other users. Use of trees for firewood are clearly rival in this sense as are use of elephants for ivory. Non-exclusivity refers to the fact that for many assets there is no economically feasible means of excluding users from their consumption. Again, trees and grazing on common land or animals in the wild display this characteristic. When the two characteristics occur simultaneously the assets in question are termed Common Property Resources and the assets are frequently characterised by over consumption or exploitation. Much of the degradation of forests, fisheries, soils and animal stocks is explicable in terms of rivalness and non-exclusivity.

Natural assets such as air, soil, beaches, commons and waterways are likewise characterised by the same two attributes. Because it is either difficult or impossible to exclude would-be users from their use, they too tend to be over-exploited. The atmosphere, waterways, etc. have a valuable use as 'free waste disposal units' to firms which would otherwise have to provide costly means of safe discharge. Although we all value a clean natural environment, the market mechanism fails to determine a market value or price. The absorptive and assimilative properties of the environment thus appear to be a temptingly free means of discharging unwanted waste materials.

Economists accept that production will often be accompanied by pollution; the concern of environmental economists is that pollution should be controlled to its socially optimal level.

THE SOCIALLY OPTIMAL LEVEL OF POLLUTION

Pollution may be viewed as a side effect or an external effect of economic activity. Suppose a steel mill extracts water from a river, uses it in its process and later discharges the water back into the river in a polluted state. A community further downstream depends upon the river as a productive and amenity resource; it provides opportunities for fishing, water supply and recreation. The activity of the steelmill has a negative impact on the community, fishing catches are reduced and illnesses strike drinkers and bathers. The steelmill owner has imposed a social cost (a negative side effect) upon the community. Seen in this way, 'free' use of the environment is not free at all, rather the bill or cost has been deflected on to the community away from the polluter.

The events above may be formalised in order to provide some insights into the effects of pollution and the means by which it may be controlled.

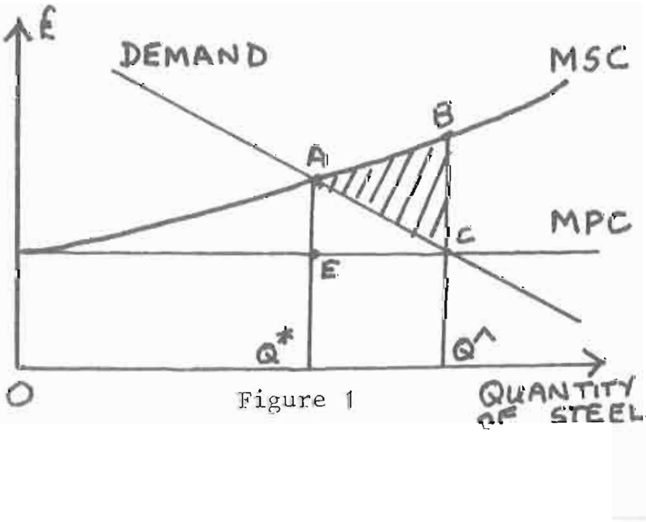

Figure 1

The Marginal Private Cost curve (MPC) shows the financial cost of producing each additional ton of steel; it represents the labour, raw material and energy costs borne by the mill owner.

The Marginal Social Cost curve (MSC) shows the true or full cost of steel production imposed on society; it includes the costs described above plus the 'side effect' costs which manifest themselves in reduced catches, higher medical expenses and lost output caused by poorer health in the nearby population.

The Demand curve shows the price society is willing to pay for each ton of steel; it shows the value in money terms placed upon each extra ton.

An owner concerned only with costs that he himself incurs would produce up to the point where the demand curve intersects his own MPC. If he produced more, his costs would be greater than the price he obtained and so his profits would be reduced. If he produced less, the price obtainable would be greater than his costs and so production at less than $\hat{Q}$ provides profit opportunities. Thus $\hat{Q}$ represents the owner's profit maximising output. If uncontrolled, self-interest will ensure that $\hat{Q}$ is produced. However, this is not an optimal arrangement from society's point of view. A better arrangement for society would be for output to be restricted to Q^*, the social optimum. Only up to Q^* does society value each extra ton (as expressed by its willingness to pay depicted in the demand curve) at more than the cost imposed on the community as shown in the MSC curve. Note that there is a social loss on the output greater than Q^*; uncontrolled the owner will produce too much relative to the social optimum. It should be noted that there is a social loss on the 'surplus' production; in money this is equal to area ABC. Also at the socially optimal level of steel production, there exists a degree of pollution. In Figure 1 this is equal to the difference between MSC and MPC at optimal production (i.e. AE) and is known as the optimal level of pollution.

Environmental Economics is concerned with finding mechanisms for ensuring that pollution is controlled to the economic optimum or, more realistically, to an approximation to it. In practice, an acceptable level of pollution is the policy objective. For developing countries, one might advocate an incremental policy of increasingly more stringent standards through time.

POLICY INSTRUMENTS

This section reviews some of the policy alternatives which are available for the control and management of pollution and degradation. Concentration here is on pollution but reference is made as appropriate to the closely related phenomenon of degradation. Although policy and its application is most developed in the industrialised world, the subject is of growing relevance to developing countries both because of their close dependence on environmental assets and the potential for pollution accompanied economic growth. Growth is not only the creator of pollution but it also offers the prospect of the resources by which it can be eliminated. A powerful pollution programme is composed of the appropriate use of alternative policy instruments; these include command and control (CAC) regulations and economic instruments (EIs). The former include the setting of pollution emission standards and legislation in such matters as allowable discharges and required abatement equipment. Economic instruments embrace market based incentives such as pollution taxes, product taxes, user charges, subsidies and assignment of property rights in an attempt to modify the economic behaviour of polluting agents.

Early policy relied heavily on the use of CAC through the imposition of emission standards. Recently, policy has tended towards greater use of EIs, a development favoured by economists (ref. 2). Specifically, the case made by economists is that a given target level of pollution can be more cheaply reached by using EIs than by using CAC methods. This point can be demonstrated by consideration of the ideas of the Marginal Damage caused by pollution (MDC) and the cost of its abatement (MAC).

The MDC of Figure 2(c) indicates that the money value of pollution damage inflicted on society increases with the amount of pollution generated. ΣMAC shows that the incremental cost of removing pollution increases as additional units of pollution are removed; very low levels of pollution may be achieved only at very high incremental cost.

The optimal amount of pollution is X units; this is because at lower levels of pollution (that is to the left of X), the cost of abatement is greater than the damage inflicted. It is cheaper for society to bear the costs of pollution than it is to remove it. A policy designed to ensure that pollution is actually restricted to X is required.

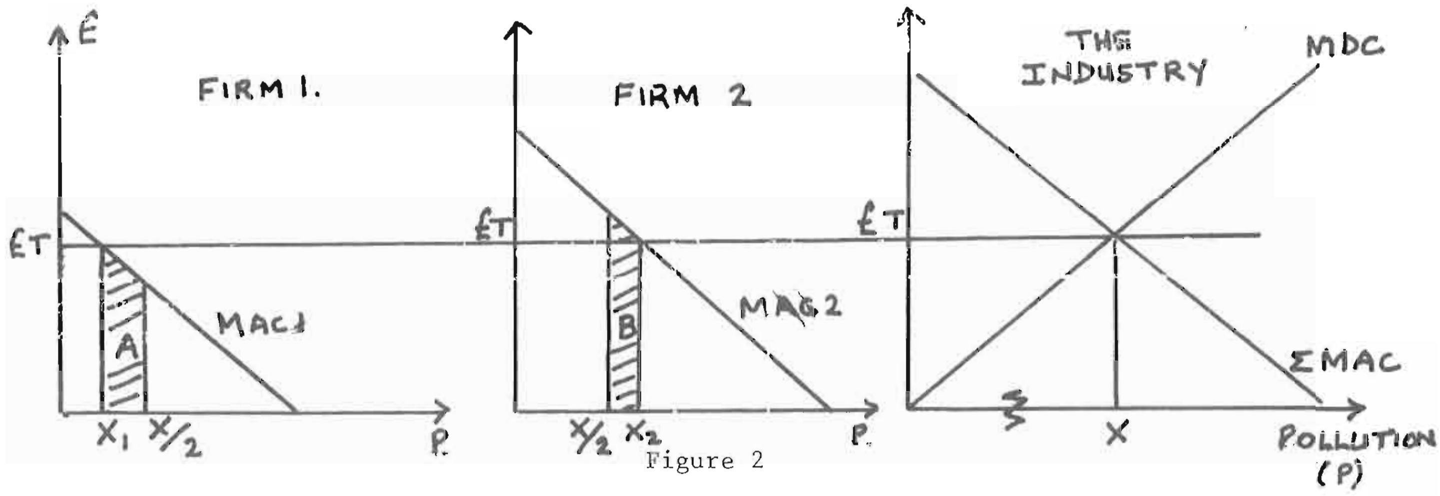

Figure 2

This could be achieved by a regulation backed up with legal sanctions which stipulated that X should not be surpassed but this would leave the problem of ensuring that the individual firm emissions were compatible with X. In a developing country, the administrative costs of ensuring compliance might be heavy and where monitoring institutions are weak polluters might evade their individual pollution quotas.

Alternatively, the same result could be achieved with the use of an EI; in this case, a pollution tax. This would be a tax levied on the amount of the specific pollutant and in Figure 2(c) would need to be £T per unit to bring about the required pollution level X. Note the market would deliver this result automatically because at pollution levels below X firms would find it cheaper to pay the tax £T and pollute than they would to bear the costs of abatement, say, by using cleaner technology. However, beyond X, paying the tax would be more expensive than abating. Using the EI has provided the result by using a firm's own self-interest rather than requiring an expensive agency setting standards with legal sanctions.

Moreover, the EI approach secures the optimal pollution level at cheaper cost to society. Referring again to Figure 2, suppose that all of this type of pollution was generated by just two firms and that the cost of abating differed between firms, which is often the case in the real world. Firm 1 is the low cost abater and Firm 2 is the high cost abater. It would be cheaper from society's point of view if Firm 1, which finds abatement less expensive, was to reduce its pollution most. MAC1 and MAC2 respectively represent the abatement costs of the two firms. Under the EI solution, Firm 1 would reduce its pollution to X1; the high cost polluter would carry on polluting to a greater degree X2.

Had a standard been used which required the X units to be split equally between the two firms, then each would have polluted to X/2. This would have allowed Firm 1 to escape some abatement costs (equal to area A), whereas B would have had to pollute less thereby incurring extra abatement costs (equal to area B). Therefore, relative to the EI solution the CAC solution is more costly by an amount B-A.

In addition to pollution changes, a range of economic instruments exist which may be selected as appropriate to deal with specific problems. The instruments generally have a revenue raising function; the proceeds may be used for environmental protection or improvement. Also, and importantly, they have an incentive function. Changing incentive regulators signals the advantage to be gained by modifying detrimental economic behaviour. This is obvious in the case of the pollution tax; changing its level makes polluting a more or less profitable activity. Other instruments include:

Product Taxes. These may be levied on products which are associated with environmental damage. For example, the much discussed EEC proposal for a Carbon Tax by which fuels would be taxed according to their carbon content, will change relative prices and by doing so change consumer choices. Power generators will find it cheaper to use relatively clean fuels. Similarly, taxes on agricultural fertilisers and pesticides would constrain their use.

Subsidies may be employed as a means of encouraging environmentally beneficial activities, e.g. farmers would have an additional incentive to invest in erosion control or reafforestation if these activities were subsidised. Perversely, it is often the case in developing countries that large subsidies are paid on potentially harmful products. In these cases, economics would argue for the removal of the subsidy and the possible imposition of a tax if pollution was significant.

Pollution Permit Trading has been introduced in the USA as a means of restricting pollution to the optimal level. Under this system the government issues a fixed number of permits to pollute which are then bought and sold at market prices by firms. High cost abaters find it worthwhile to buy permits, whilst low cost abaters find it profitable to sell them. The system is appropriate for developing countries as once the government has fixed the total allowable pollution level, self-interest will ensure the limit is met at least cost.

User Charges are commonly imposed in OECD countries with respect to collection and treatment of municipal and solid waste and wastewater discharged into sewers. Generally, the charges are fixed so as to cover total expenditure but some examples have an incentive effect; these include the US water pollution strength charge and the French household waste collection charge which is volume based.

Debt-for-Nature Swaps provide the means by which natural assets may be protected from degrading economic activities. They afford opportunities for both protection and remedial environmental work. Essentially the swaps provide for the assignment of property rights to conservation agencies where previously assets were depleted because of the absence of such rights or because they could not be exercised. The typical mechanism is that an environmental group buys debt of a LDC government at a discounted price. Usually the seller is a commercial bank and the price is well below face value. Then, the environmental agency exchanges the acquired debt with the debtor LDC which issues a bond or cash. The interest from the bond or the cash is then used by the environmental group to finance environmental projects inside the debtor country. The mechanism works because the debtor country reduces its debt burden, the agency holding the debt at least gets something back and the environmental group is able to implement the protection, conservation or remedial work.

Between 1987 and 1991 swaps were arranged cancelling $20m. of debt involving Bolivia, the Dominican Republic, Madagascar, Costa Rica, Mexico and Ecuador. Projects protecting rain forests, endangered plant and animal species have been implemented during this period. The scheme has further potential both in geographical coverage and scale.

CONCLUSION

There exists a growing number of EIs to deploy in the fight against environmental pollution and degradation. The issue is of central concern to developing countries because of their dependence on natural assets and their growth potential. EIs may be introduced incrementally and often are cheaper than CAC approaches. Because they utilise economic self-interest, they are administratively attractive to countries with only embryonic institutions. The skill in pollution policy formulation is to send the 'right signals' to producers.

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