“Theory of Economic Instruments”

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Chapter 3

in

The Fiscal System and the Polluter Pays Principle: A Case Study of Ireland

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3 Theory of economic instruments

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In this chapter, we will present the economic arguments in favour of the use of economic instruments for environmental protection. For those familiar with this material, the chapter can be skipped without any loss. For those who wish to read a very brief outline of the arguments, such an outline is presented in the concluding section of the chapter.

3.1 The problem that economic instruments seek to address[1]

Environmental policy is concerned with reducing the amount of environmental degradation that arises due to a range of human activities. Typically, production and consumption lead to the generation of waste in the forms of solid or liquid waste and air-borne particles. When the assimilative capacity of the environment is unable to fully absorb this waste, environmental degradation occurs. Similarly, when human activities put demands on resources at rates that exceed their re-generative capacity, a negative environmental outcome emerges. And finally, when human activities intrude on either natural environments, or built environments of cultural and social value, the quality of the environment is reduced and hence the wealth of the nation is reduced also. In Chapter 1 we mentioned examples of the environmental pressures being faced in Ireland and more examples will be provided in the chapters that follow.

The use of policy to reduce the type of environmental degradation just described presupposes that the degradation is in some sense excessive. In addition, policies that seek to reduce levels of pollution implicitly assume that there is something desirable about the target levels. In an extreme case, a policy that would reduce pollution to zero says that zero-level pollution is optimal.

In opening our discussion of the theory of economic instruments supporting environmental protection, it is helpful to consider first the economist's view of why the level of pollution in the absence of government intervention might be greater than society would want. We also consider what the optimal level of pollution might be and demonstrate the circumstances in which this level is greater than zero. We show how it is possible that this level of pollution may be reached without government intervention, through negotiation between private parties. As this 'no-government' solution is unlikely to emerge in reality, we go on to look at the possibilities for government intervention through the use of economic instruments. In an ideal situation, such economic instruments could be used to achieve the optimal level of pollution. However, in reality economic instruments are more likely to be used to achieve what we can describe as acceptable levels of pollution.

Even in achieving this more limited objective, it will be shown that economic instruments have important advantages over the more traditional and widely used regulatory approaches to environmental protection. First, economic instruments allow the same amount of pollution abatement to be achieved at a lower cost. Second, economic instruments in the form of taxes and charges allow for the possibility of reducing other taxes which have negatively distorting effects, in addition to aiding environmental protection; this is the so-called 'double dividend'. Third, economic instruments provide an on-going incentive for pollution abatement; this dynamic incentive is not present under regulatory measures.

3.2 Sub-optimal and optimal levels of pollution

To see why economists believe that the level of pollution may be above that which is optimal in the absence of government intervention consider Figure 3.1.

In this figure we are depicting an enterprise (be it an industrial plant as in Chapter 5 or a farm as in Chapter 4) whose production gives rise to pollution. The vertical axis measures monetary values while the horizontal axis measures output. For now we will assume that there is a one for one link between output and pollution but this assumption will be relaxed later in the chapter and its implications discussed. As output increases, its associated pollution also increases and this is represented in the diagram by the marginal external cost (MEC) line. 'External cost' refers to the cost that pollution imposes on people other than the firm responsible and for which these others are not compensated. 'Marginal' means we are describing the cost associated with each additional unit of output. Although this is a cost of production from society's point of view, the firm does not take it into account in making its production decision. It is only interested in the net benefits it derives from production, and this is represented by the marginal net private benefit (MNPB) line. This line is derived by subtracting the private marginal cost of each unit of output from the price received, that is, for each unit of output we subtract the cost to the firm from the price received by the firm. With a given price and a rising marginal cost[2] , MNPB decreases as output (and pollution) rises. MEC rises as output rises on the assumption that the external costs of additional pollution rises as the level of pollution rises.

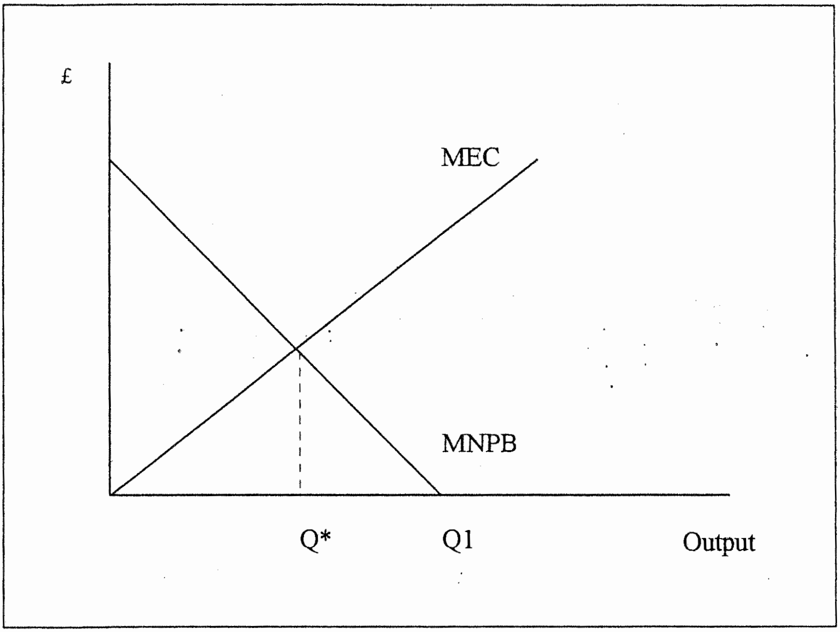

Figure 3.1 The optimal level of pollution

Without government intervention the firm will maximise its net private benefits. In terms of the diagram, it will produce additional units of output as long as MNPB is positive and so production will be at the level Q1. At this level of output the MEC of the associated pollution is greater than MNPB so although the firm is better off at this level of output than at a lower level of output, society at large is worse off. By reducing output, the benefits to society from a lower external cost of the pollution is greater than the loss of net benefits to the producer and so the welfare of society at large would be higher at lower levels of output.

It is for this reason that economists view the level of pollution when output is at level Q1 as being sub-optimal, i.e. the welfare of society at large is not maximised when output and pollution are at this level. In essence, the reason for the sub-optimal outcome is that the pollution costs are external to the market mechanism and so this mechanism, which under normal circumstances produces socially optimal allocations of resources, produces a sub-optimal outcome in this case. By extending the logic, we can establish the level of output that is consistent with the optimal level of pollution. By reducing output from level Q1 the external costs of pollution are reduced by a greater amount than the net private benefits of that pollution, at least up to output level Q^*. Reducing output below level Q^* reduces net benefits more than external costs. As such output level Q^* is consistent with a level of pollution that maximises social welfare.

3.3 Achieving optimal pollution levels without government intervention (The Coase Theorem)

The externality just described would lead one to believe instinctively that government intervention was required for the social optimum to be arrived at. This was accepted without question until 1960 when Coase produced his famous theorem.[3] Coase's idea is as follows. Suppose residents in an area have a property right such that they are entitled to an environment with no pollution. Initially this will mean that the firm in Figure 3.1 will not operate. However, as the net benefits of production to the firm exceed the costs to residents at lower levels of production the firm could bargain with the residents and offer to compensate them for the cost of the pollution. In order for this to happen, we must assume that the costs involved in arriving at such a deal, i.e. the transactions costs, are zero or at least relatively low. In this way, the residents can be made as well off as they were before while the firm is better off. Such compensation will continue up to output Q^*. After that level of output, the compensation required by residents is greater than the net benefits earned by the firm so that output level will not be exceeded and the social optimum is achieved.

Such an outcome can also be attained if the firm has the property right and is allowed to pollute. In this case output will initially be at level Q1. Those suffering the pollution now have an incentive to bargain with the firm and to compensate the firm for reducing its output. At higher levels of output this is possible because the gains to the residents exceed the losses to the firm. Such compensation will continue up to output level Q^*, after which the compensation required by the firm would exceed that which the residents would be prepared to pay and so again, the social optimum is arrived at without government intervention. It should also be pointed out that the final production/pollution outcome does not depend on who is given the rights to the environment. The only result that differs between the two rights allocations is the distribution of costs between the firms and residents, in that the polluters pay in one case and the victims of pollution pay in the other case.

While the Coase Theorem is certainly an enormously clever theoretical argument, it is based on assumptions violated in the real world, so that the type of bargaining and compensation envisaged rarely occurs. We need only point out the main real world difficulty for this to be seen. Transactions are not costless and so there is no guarantee that they will occur. In the example we are discussing, the transactions costs would likely be prohibitive, such as the costs of organising the residents in such a way that their compensation requirements could be measured and voiced. It may even be difficult to establish who are the victims of pollution, especially when the effects of pollution manifest themselves over a long time. For these reasons, the Coase Theorem has not convinced many economists that government intervention is unnecessary in the face of externalities. Instead, economists have sought to work out how intervention can be most efficiently conducted. It is the output of these efforts that informs the discussions in the following chapters so we will now discuss the insights which have been derived.

3.4 Using economic instruments to achieve the optimal level of pollution

The use of economic instruments, in the form of taxes, to produce optimal environmental outcomes was first proposed by Pigou.[4] In order to see how the Pigovian tax works we reproduce the essence of Figure 3.1 in Figure 3.2.

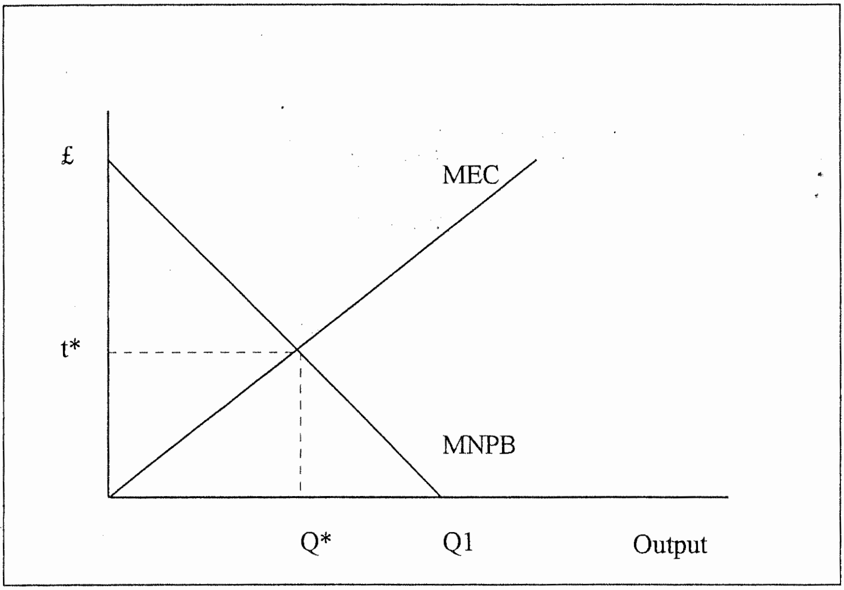

Figure 3.2 The Pigovian Tax

Once again, the firm faces the MNPB curve as shown while society at large faces MEC arising from the firm's production decisions. In the absence of government intervention or a Coasian-type bargain, the firm will produce output level Q1. The imposition of a tax on output, equal to t^*, alters the firm's production decision. At output levels above Q^* the marginal net private benefit is less than the tax which the firm faces if it produces the additional output. For this reason, it is no longer optimal for the firm to produce Q1; its optimal level of output is instead Q^*. The tax has 'internalised' the external cost that the firm imposes on society and so the socially optimal level of output now corresponds with the firm's optimum. In order for the tax to bring the level of output to the social optimum it must equal the marginal external cost of the pollution at its optimal level. This can be seen in the diagram or shown mathematically.

The ideal Pigovian tax is clearly a powerful economic instrument but it has practical limitations. In order to set the tax, it is necessary to know the marginal cost of pollution, not just at its current level, but at its optimal level. This is a task which, though possible, would be costly and time-consuming as it involves undertaking contingent valuation studies or estimating values using hedonic pricing analysis. For this reason the setting of ideal Pigovian taxes in all instances is not possible. However, this does not mean that there is no benefit to be derived from the use of environmental taxes or other economic instruments. As we demonstrated above, the level of pollution in the absence of government intervention is likely to be above the optimum so some amount of pollution reduction is likely to be an improvement. Where economic instruments can be most beneficial is through achieving such reductions at lower costs than the alternative regulatory approach. We will now move on to show how this can be under the headings: (i) taxes, charges and subsidies, (ii) tradeable permits and (iii) deposit-refund schemes.

3.4.1 Taxes, charges and subsidies

In this section, we move away from thinking in terms of the optimal level of pollution as defined by the equality of marginal external costs and marginal net private benefits. Instead we will work with a situation in which an acceptable level of environmental quality is chosen; it could be argued that this level represents a socially derived proxy for the optimum. We continue to maintain that the choice should be informed by an effort to put a value on the environmental quality being pursued but once a level is chosen, the task for policy makers is to achieve this level at the lowest possible cost. In Figure 3.3 we show how taxes can achieve such a level at a lower cost than regulations.

Figure 3.3 differs from Figures 3.1 and 3.2 in that the horizontal axis now represents pollution. The new lines show marginal abatement costs (MAC) for two enterprises. These are the costs to enterprises of taking action to reduce pollution, which could mean reducing output or installing pollution control processes and technology. An example might be a pharmaceutical company which could install a waste water treatment plant instead of emitting waste water into a nearby stream. The MAC lines slope upwards from right to left for the following reason: pollution will be eliminated initially using the cheapest route but as the cheaper routes are exhausted the more expensive ones must be taken. Alternatively, one can think in terms of initial reductions being easier and hence cheaper but that further reductions are more difficult and hence more expensive.

Suppose the government decides that pollution should be reduced and issues a regulation saying that each firm must control its pollution to a level Pg. Since the government will not have detailed information on each firm's cost structure it cannot identify the relative abatement costs of the two firms. It can be seen from the diagram that for one firm the marginal cost of pollution abatement at Pg is greater than for the other. Specifically, the marginal abatement cost schedule of firm 1 is MAC1 and that of firm 2 is MAC2. Starting from Pg, if firm 1 increased its pollution by one unit while firm 2 reduced its pollution by one unit, the additional cost incurred by firm 2 would be less than the cost saving achieved by firm 1. In this way, the same level of pollution is achieved but at a lower cost to the economy. As long as MAC1 is greater than MAC2 such cost savings are possible. Once the

MACs are equal, the chosen level of pollution abatement is achieved at the lowest cost.

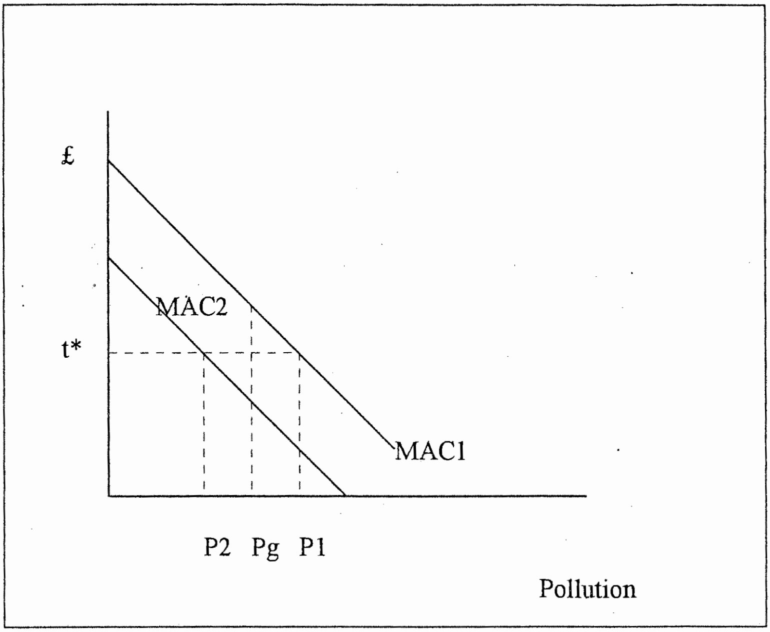

Figure 3.3 The least-cost property of taxes

Now suppose that instead of imposing a regulation the government imposes a tax on pollution equal to t*. Each firm will produce output, with its corresponding pollution, as long as the MAC is greater than the tax since the firm would prefer to pay the tax than incur the higher abatement cost. For firm 1 this means that pollution will occur up to level P1 while firm 2, for whom pollution abatement is cheaper, will only pollute up to level P2. The tax can be set in such a way that P1+P2 is equal[5] to 2Pg. In this way the same level of pollution is achieved under the two policy regimes but under the tax situation MACs are equalised across the two firms, i.e. they are both equal to t, and by the logic of the previous paragraph this implies that pollution abatement is cheaper under the tax situation.[6]

In much of the following chapters, this approach of taxing polluters will form the basis of our analysis. Our focus will be on providing polluters with an incentive to reduce their pollution by taxing them in such a way that the external costs of their activities become internal to their decision-making process. And where possible, the level of the taxes we suggest attempt to follow the Pigovian requirement of reflecting the value of the external cost.

The taxation of pollution has been described as the stick approach to environmental management. An alternative approach in the manner of a carrot has been proposed, that of subsidies. Not only were subsidies proposed as an alternative to taxes but it was argued that essentially symmetric results could be achieved with either approach. Referring again to Figure 3.3 we can develop the logic underlying the subsidy proposal. Suppose that instead of taxing pollution at tax rate t*, firms are paid a subsidy equal to t* for each unit of pollution reduction. Starting at higher levels of production, firms see that the amount of the subsidy is greater than the MAC and so pollution reductions yield net benefits, to the firms and society. However, for each firm, once MAC exceeds t* there is no longer a net benefit to pollution reduction and so such reductions cease. As in the tax situation, firm 1 reduces its pollution to P1 while firm 2 reduces its pollution to P2. As MACs are equalised we would appear to have the same low-cost solution as we did under the tax regime. The only difference between the tax and subsidy approaches would appear to be that the costs of pollution abatement are borne by the firms on the one hand and by the taxpayer, via the government, on the other.

While the two firm, static approach yields insights that are still valid in a more expanded model for the case of taxes, this is not the case with subsidies. When we take account of other firms and the dynamic character of decision making, we see that the apparent symmetry between the tax and subsidy approaches no longer holds.

While taxes increase the average costs for firms, subsidies reduce average costs. Now consider a marginal firm in an industry that causes pollution.[7] Under the tax approach, the increase in average cost will push the firm into a loss making position and so it will exit the industry. This will lead to a reduction in pollution. But in the case of a subsidy, average costs are lower and so the marginal firm is moved into a more profitable position. In addition, the reduction in average costs may allow a firm that previously would have been in a loss making position to enter the industry, thereby adding to pollution. In this way, although the subsidy may reduce pollution at the level of the individual firm, it can increase pollution by attracting more firms into the industry.[8] In addition, the availability of subsidies may create the expectation of further subsidies and so reduce incentives for firms to undertake pollution abatement themselves. In an extreme situation, pollution could be encouraged as firms attempt to gain from subsidies.

An additional point should be made regarding subsidies. For the government to pay a subsidy, it must raise revenue through taxes. However, as taxes distort the allocation of resources and hence move the economy away from the most efficient allocation, the cost of the subsidy should not be taken to be simply the same as its value in pounds. It has been estimated in Ireland that an adjustment factor of 1.5 should be used to establish the true cost of providing a subsidy with public money (Honohan, 1996).

From this we can conclude that taxing pollution leads to the achievement of a given level of pollution at a lower cost to society than a regulatory approach which imposes equal pollution reduction requirements on firms. Subsidies do not share this efficiency property. And on a more philosophical point, subsidies, by requiring the victims of pollution to pay for the clean-up imply an allocation of property rights that is in contradiction of the Polluter Pays Principle.

3.4.1.1 Differential taxes The tax/charge tool just described aims to raise the price of a good or input relative to all others and so to generate a substitution away from the good or input in question and towards any others. It is also possible, however, to use taxes and charges in an effort to generate a more targeted substitution effect.

If two goods[9] are close substitutes and one is a clean good while the other is a dirty good, it will be possible to generate a substitution between the two by altering the rates of tax between them. An example of this would be the differential rate of excise duty on leaded and unleaded petrol. The question arises though of what size the differential should be. In the case of the Pigovian tax above, we were looking for an absolute tax level; in the differential tax case, it is relative tax rates that matter. As such, it is necessary to establish what level of substitution between the two goods is optimal and then to establish what tax differential will establish this.

3.4.1.2 Fines Fines for polluting will have similar incentive effects to charges and taxes although the philosophy underlying them is quite different. While taxes and charges allow emissions, fines reflect an underlying view that emissions above and beyond a certain level are 'wrong' and so punishment should be imposed on those who violate the predetermined standard. In this way, fines blend elements of the regulatory approach (requiring standards to be set) with the economic instrument approach (providing economic incentives not to pollute).

As in the case of differential taxes, the question arises of what level the fines should be. Before answering that question, however, it firstly has to be determined what the probability of detection will be. In deciding how to react to the existence of fines potential polluters will balance the level of the fines and the probability of having to pay them with the economic benefits of polluting. If either the fines or the probability of detection (or prosecution) is low, the potential polluter may decide that the risk is worth taking and so will pollute. Hence, the size of the incentive not to pollute will depend on two parameters and decisions on the level of fines cannot be taken in isolation from decisions regarding the extent of monitoring. In the extreme, if monitoring was perfect the fine would essentially act as a charge on pollution beyond the standard, and would have similar effects to a tax if it was structured in such a way that bigger violations of the standard implied higher fines.

3.4.2 Tradeable permits

An alternative way of achieving specified levels of pollution at a lower cost than regulation is that of tradeable permits. We develop the theory behind tradeable permits using Figure 3.4. We begin by assuming that the government decides that it will allow P^* units of pollution. It tells firms that they must buy permits which will allow them to emit units of pollution and that these permits[10] are priced at Pr. From the diagram we can see that firm 1 will buy more permits than firm 2 and that MACs are equalised. Hence, we have our least-cost condition satisfied and so we can see how permits share the tax efficiency property.

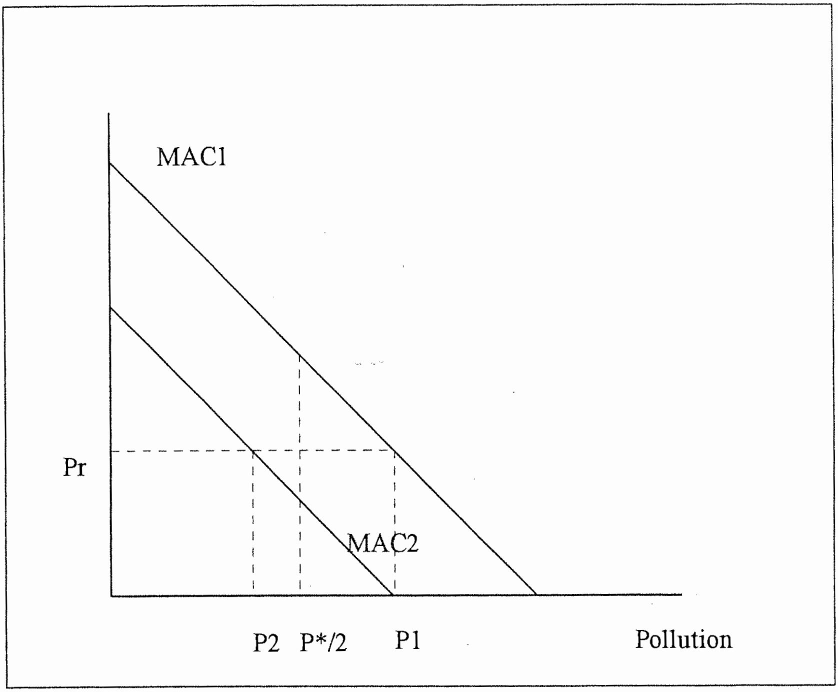

Figure 3.4 A tradeable permit scheme

Permits as economic instruments work differently from this in practice so we will now show how they work and how again MACs are equalised. The government gives permits to each firm, allowing them to emit $P^*/2$ units of pollution each, assuming that each permit allows for the generation of one unit of pollution. In this way the government constrains the level of pollution to be P^*. So far this is the same as the regulatory approach described above in which each firm is told how much it can emit. Tradeable permits move a step further, however, and as the name suggests, firms are allowed to trade their pollution allocation. In the case of the two firms shown, firm 2 will be prepared to sell permits as long as the price it can charge is greater than its MAC. By selling a permit it will have to reduce pollution by one unit. But as long as the selling price is greater than its MAC, there is a net benefit to selling the permit. By a similar reasoning firm 1 will find it optimal to buy permits as long as the price is lower than its MAC. These trades will continue as long as MAC1 is greater than MAC2 and cease once they are equal, at which point the permit price will be Pr. The equality of MACs implies, as before, that the least cost approach to pollution abatement has been achieved. Once again, we see that the firm for which pollution abatement is cheaper does more abatement so our intuitive expectation is confirmed.

The United States has pioneered the use of tradeable permits. The 1977 Clean Air Act set up a scheme whereby companies that had restricted emissions more than was required were given credits for the excess reduction. These credits could then be traded in a number of ways. One such way was to sell these credits to firms that were setting up. In this way, emissions in an area could be capped without unduly restricting industrial entries.[11] Such schemes are not used in Europe to the same degree; this may reflect a greater acceptance of taxation measures in Europe relative to the United States. In the case of Ireland, the use of such schemes will generally be constrained by the lack of sufficiently large markets in emission permits. For this reason, we will not, in general, be suggesting the setting up of such schemes. However, it is possible that an analysis of industry at a level below our sectoral focus could point to a viable scheme so we do not wish to suggest that the issue be ignored.

3.4.3 Deposit-refund schemes

Deposit-refund schemes are a more narrowly based economic instrument. They operate through the imposition of a surcharge on a product at its point of purchase, and the subsequent refund of this surcharge once the product or its packaging are returned to a defined point. Typically they are concerned that the disposal of the product or its packaging (or their re-use or recycling) is done in a way that generates the minimum amount of pollution. For example, when applied to beverage containers the aim would be to reduce littering and to increase re-use and recycling. In the case of batteries, the aim would be to avoid dumping which could lead to groundwater pollution and instead ensure safe disposal.

Deposit-refund schemes, rather than being judged relative to regulation in terms of cost effectiveness, are seen to have an advantage in terms of bringing about levels of return that could not be achieved using regulation. For example, in the case of beverage containers deposit-refund schemes have achieved return rates of over 90 per cent.[12] A regulation requiring each household to return 90 per cent of their beverage containers would obviously be unworkable due to monitoring problems.[13] The difficulty in designing and implementing these schemes is in determining whether the costs involved in generating these rates of return, such as storage and transport, exceed the benefits. But if an evaluation of the benefits of, for example, the recycling of beverage containers indicates that a scheme that can achieve high rates of return is desirable, then a deposit-refund scheme will likely achieve this at lowest cost.

3.5 Relaxing the assumption that equal amounts of emissions create equal amounts of pollution

In Section 3.2, we made an assumption that there was a one to one relationship between emissions and pollution. In reality, this assumption is often violated. For example, a firm emitting untreated waste-water into a large river with a heavy current will cause much less pollution than a firm emitting the same volume of the same effluent into a stream. In circumstances such as these setting taxes or charges on the basis of emissions, or issuing permits on the same basis, will not lead to the least cost approach to pollution abatement. In the case of the two firms, it is clear that the firm whose emissions are more polluting should face a higher tax or a higher cost for emission permits in order for the least cost properties of the economic instruments to be restored.

In the case of taxes and charges, two proposals have been made to overcome the breakdown in the simple relationship between emissions and pollution.[14] The first proposal is to tax on the basis of two or more parameters instead of the single parameter, emissions. The two parameters could be emissions and the existing level of pollution of the receiving medium, whereby for given levels of emissions the tax would be higher, the more polluted was the receiving medium. Alternatively, if the emissions of firms in a particular zone have similar impacts, but impacts differ across zones, the taxes or charges could be varied across those zones.

In the case of either the two-parameter tax or the zone-based approach, there is an implicit trade-off between designing the tax to achieve the least cost properties and the administrative complexity that could emerge. Clearly, a balance should be achieved but in designing the tax it is instructive to be mindful of this complication introduced when the simple emission/pollution relationship is violated.

This issue has also been addressed in the case of tradeable permits. To see how the difficulty might be overcome, we will consider the design of three alternative tradeable permit schemes. These are (i) emissions-permit system (EPS), (ii) ambient-permit system (APS) and (iii) pollution-offset system (PO).

(i) Emissions-permit system[15]: Were there a one to one correspondence between emissions and pollution, this system would be the appropriate one. Permits are defined in terms of emissions and emission entitlements are traded on a one for one basis. The result of such a system is that all firms face the same cost of emissions. However, as was the case with taxes, if emissions differ in terms of their polluting impact across firms, this will not produce the least cost approach to pollution abatement. Again like the tax system, if emissions from firms within a zone have similar polluting impacts, restricting permit trades to within that zone may substantially overcome this problem. The ambient-permit and pollution-offset systems are more sophisticated ways of overcoming this deficiency, so let us consider each.

(ii) Ambient-permit system: Under this system, permits are issued for a number of receptor points and each permit allows some contribution to pollution at that point. Firms must then buy permits for a range of receptor points and emit only to a level where the resulting pollution is within their limit for each receptor point. Given that the permits are defined in terms of pollution and not emissions, the emission entitlements will not be traded on a one for one basis. A firm whose emissions are relatively more polluting will have to acquire relatively more permits if it is to increase emissions by the same amount as a firm whose emissions are less polluting. Hence, emissions will be more expensive for such a firm, which is desirable.

A difficulty with this system can be seen when one considers the receptor points more closely. A network of points that was spread too thinly might 'miss' pollution that was arising due to the changing location of production. To overcome this, a large number of receptor points would be needed. However, as firms have to buy permits for each receptor point, a large number of such points could put quite a burden on producers.

As the EPS may not provide the least cost approach to pollution abatement and the APS entails cumbersome requirements, an alternative system combining the advantages of both is required. This exists in the form of the pollution offset system (PO).

(iii) Pollution-offset system: Under this system, permits are defined in terms of emissions (as with EPS). However, trades in permits are subject to the constraint that the trade should not result in pollution at a receptor point exceeding some standard (as with APS). In this way, trades at the boundary of the pollution constraint will occur on the basis of pollution and not on the basis of emissions.

3.6 The 'double dividend'

We noted in the introduction that it has been argued that environmental taxes possess a positive feature in addition to their role in protecting the environment. The argument is as follows. Given that revenue is generated through the imposition of these taxes, this revenue can be used to reduce other taxes. If the revenue is then used to reduce what are known as distortionary taxes, then the cost of the tax system, in terms of the distortions it creates, is reduced. Hence one benefit of environmental taxes is environmental improvements and the other is the welfare increases, above and beyond the welfare benefits associated with the environmental improvements, that are associated with a switch away from the distortionary tax.[16] It was Pearce who first coined the phrase 'the double dividend' to sum up the argument (Pearce, 1991).

Since the idea of the double dividend was originally advanced, it has undergone a large amount of theoretical investigation, much of which has called into question its existence. Given the highly theoretical nature of much of this work, we will not review the literature on the topic.[17] We simply want to point out that there is a controversy over the existence of the double dividend and so there is a difficulty in using it as an extra argument for the introduction of economic instruments.

We can, however, describe one piece of research that has been undertaken on the issue in Ireland. In their 1992 paper, Fitz Gerald and McCoy use the ESRI HERMES-Ireland macroeconomic model to estimate the effects on the Irish economy of a carbon/energy tax of US$10 per barrel of oil. They investigated two scenarios, one in which the revenue was used to reduce the national debt and one in which it was used to reduce the social insurance tax on employment. Turning specifically to their estimates of the employment and unemployment effects under the tax reduction scenario, they find that employment would increase by between .5 and .8 per cent although reduced emigration would essentially neutralise the effect on unemployment. As such, we can take this as providing some evidence of a double dividend, if we take the second dividend to mean increased employment. The carbon tax will be discussed again in Chapter 6.

3.7 Other issues

3.7.1 When to regulate

It would be incorrect to leave the impression that all environmental threats can be, and should be, dealt with using economic instruments. There are certain circumstances in which regulation is the preferred policy tool and so we must set out what these circumstances are.

Regulations such as standards, permits and quotas possess an important feature: they provide greater certainty as to their environmental outcome than many economic instruments. It is when this greater certainty is of particular importance that regulation should be relied upon. There are two broad circumstances in which this will apply. First, where the consequences of the environmental threat are sufficiently dangerous, it would be wrong to leave control of the threat to fiscal instruments. For example, emissions which may threaten human life should be subject to regulations. Second, when the environmental threat is such that its consequences are both important and irreversible, it would again be incorrect to rely on fiscal instruments. An example of this would be the protection of endangered species; if a species was to be lost because hunting charges turned out to be too low, the cost of the mistake could be enormous. A combination of regulation and economic instruments may often be the best policy.

3.7.2 Employment, competitiveness and who should pay for environmental protection

It will be argued that economic instruments for environmental protection, other than subsidies, should not be introduced in Ireland because this will put businesses here at a competitive disadvantage and hence job losses would occur. There are a number of elements to this discussion so let us deal with each in turn.

The first issue relates to the costs of environmental protection policy in general and in particular, who should bear those costs. As we discussed in the section on the Coase Theorem above, one can think about who should pay in terms of property rights. If the population in general is granted the right to clean air and clean water, those who intrude upon that right must pay to do so. Alternatively, if the right to pollute is given, for example to industry, those wanting clean air and clean water must pay.

As Ireland accepts the Polluter Pays Principle, there is an implicit recognition that the property right belongs to the nation at large and that polluters must pay if they are to use the environment for extractive or sink-hole purposes. If we take this as given, it is in the interests of polluters and the economy that the cost of environmental protection is as low as possible. As we have demonstrated, economic instruments will generally provide the lowest cost approach and it is for this reason that we believe economic instruments to be in the interests of polluters as well as society in general.

While this least cost property of economic instruments may hold in general, there will be sectors, enterprises and households which may have to pay more under the proposals which will be made in the following chapters and the argument may be made that this extra cost could lead to job losses. Our response would be the following. By allowing firms to use the environment at a cost that does not reflect the burden of environmental degradation which they impose, these firms are being implicitly subsidised. If a subsidy is required to keep these firms in business, as is implied by the competitiveness argument, it would be preferable to subsidise another input, such as labour, that does not lead to the environmental damage which we are concerned about. By allowing firms to use the environment at less than full cost, we are essentially giving a resource away and giving enterprises the right to use the resource as they wish. This is in direct contradiction of the polluters pays principle and creates a situation in which environmental degradation is guaranteed.

3.8 Summary

In this section, we will briefly outline again the advantages of economic instruments and in particular the taxing and charging approaches to environmental management which informs much of the discussion in the following chapters.

Economic instruments for environmental protection are seen as having three advantages over the traditional regulatory approach. First, they can generate the same level of pollution abatement at a lower cost than regulations. In essence, the reason for this is that when each enterprise is faced with a tax or a charge on, for example, emissions, it can decide for itself how to react. Firms for which pollution abatement is cheaper will undertake more abatement relative to other firms. Under regulations, where all firms are required to undertake a given level of abatement or to install a particular technology, the information advantage which each enterprise has regarding the ease with which it can reduce waste or emissions is left unused. Just as a decentralised approach to production and consumption in general leads to economically efficient outcomes, so too can the efficient use of the environment be generated by bringing the advantages of the market mechanism to bear.

The second main advantage of economic instruments is that their use creates an on-going incentive for pollution abatement, a feature not generally shared by regulations. If a charge is in place, there will always be a potential advantage to reducing emissions because liabilities under the charge will be reduced.

Finally, the use of economic instruments such as taxes and charges can lead to the generation of revenue which can in turn be used to reduce other taxes. While this advantage is true at a basic level of analysis, more complex analyses have questioned the broader economic implications of such tax changes. As such, we will not put too much emphasis on this advantage and will instead concentrate on the role of economic instruments in environmental protection.

The economic instruments which can be used are: taxes (including differential tax rates), charges, subsidies, tradeable permit schemes, fines and deposit-refund schemes. As our primary goal is to ensure that the Polluter Pays Principle is adhered to, we will place most stress on instruments that facilitate this, notably taxes and charges and tradeable permits.

Notes

1. Much of the discussion is taken from Pearce and Turner (1990).
2. We are assuming that the firm is in a perfectly competitive market and so it faces the same price regardless of its level of output. The assumption of a rising marginal cost is a standard assumption regardless of market structure and is based on the notion of diminishing marginal returns.
3. Coase, Ronald (1960) 'The Problem of Social Cost', *Journal of Law and Economics* Vol. 3 pp. 1-44. It should be noted that this paper was partly responsible for Coase winning the Nobel prize in Economics.
4. Pigou, Arthur (1920) *The Economics of Welfare* (First Edition) London: Macmillan.
5. Even if the tax rates which will induce the firms to pollute at levels P1 and P2 are not known initially, the rates can be adjusted over time so as to bring about the desired level of pollution. Having said that, it is an advantage of regulation over economic instruments that a greater degree of certainty over outcomes can be attributed to the former relative to the latter.
6. The simple two firm model can be generalised to a model of n firms. Baumol and Oates (1988) present a mathematical proof of the proposition that:'A tax rate set at a level that achieves the desired reduction in the total emission of pollutants will satisfy the necessary conditions for the minimisation of the program's cost to society'.
7. By marginal we mean price is equal to average cost and so the firm is just breaking even.
8. On this point Baumol and Oates (1988) demonstrate the following proposition: 'In a competitive industry, where polluting emissions are a fixed and rising function of the level of industrial output, equal tax and subsidy rates will normally *not* lead to the same output levels or to the same reductions in total industry emissions. Other things being equal, the subsidy will yield an output and emission level not only greater than those that would occur under the tax, but greater even than they would be in the absence of either tax or subsidy.'
9. Anything we say with regard to goods in this section applies also to inputs.
10. As with the tax on pollution, the government may not know initially how many permits will be bought at the price Pr and hence how much pollution will result. But again like the tax, the price can be adjusted in each period. However, in practice the quantity as opposed to the price of the permit will be set and so this uncertainty does not arise.
11. This point is taken from Pearce and Turner (1990).
12. Porter (1983) found that Michigan's scheme for beverage containers achieved a return rate of 95 per cent.

13 One could make the argument that the enforcement costs of a regulation requiring households to return a given percentage of their beverage containers would be large relative to the costs involved in achieving the same return percentage using a deposit-refund scheme.

14 Baumol and Oates (1988).

15 This is the type of system described in Section 3.4.2.

16 It should be noted that the notion of a welfare increase is not the same as an increase in GNP or employment. Its precise meaning will be discussed later in the text.

17 Readers interested in a fuller review of the theoretical, and the empirical, work on the double dividend should consult Goulder (1995).

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