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Environmental Taxation

Much of this book discusses how to design the tax system to avoid unintended or undesirable effects on people's decisions about how much and in what way to work, spend, save, and invest. In this and the next two chapters—focusing on climate change and motoring—we consider taxes in a rather different light: as instruments specifically designed to alter behaviour in ways deemed desirable by the policymaker. Taxes are among the most important economic instruments available to deal efficiently with pollution and thereby help protect the environment. Some[1] also believe that environmental taxation has the potential to transform the tax system by raising large sums of money that could be used to finance significant cuts in other taxes.

The basic rationale for environmental taxation is clear. Pollution imposes costs on society that are not borne by the polluter. Imposing a tax[2] ensures that the polluter takes account of (or 'internalizes') these wider costs when deciding how much to pollute. On this basis, a reasonable goal is to reduce pollution to a level that takes full account of both the costs of the pollution and the benefits of the polluting activity. Taxes are often more effective than regulation as a way to achieve this.

In this chapter, we address some of the main economic issues in the design of environmental taxes. We do see a greater role for environmental taxation, but not to the extent that it will transform the composition of the tax system.

[1] e.g. the Green Fiscal Commission (http://www.greenfiscalcommission.org.uk/).

[2] Often known as a Pigouvian tax, following Pigou (1920).

We are also clear that taxes alone will often not be enough. There is a role for other policies to achieve the desired outcome.

10.1. PRINCIPLES AND PRACTICE OF ENVIRONMENTAL TAXATION

The use of regulations to improve the environment has a very long history. Londoners were complaining about the noxious effects of burning sea coal as early as the 12th century.[3] The first environmental legislation in the UK was the Smoke Nuisance Abatement (Metropolis) Act of 1853, with landmark Clean Air Acts following in 1956 and 1968. This was highly effective in reducing harmful health effects. The Air Pollution Control Act was passed in the US in 1955. Similar regulatory tools have been used throughout the world to deal with pollution.

More recently, taxes and other instruments that work by changing prices have become much more prominent in dealing with environmental externalities. In 2006, there were about 375 environmentally related taxes in OECD countries plus another 250 or so environmentally related fees and charges.[4] The UK is reasonably typical. There have been three new national environmental taxes in the UK in recent years, on landfill (the landfill tax introduced in 1996), on industrial energy use (the climate change levy introduced in 2001), and on the extraction of aggregates (the aggregates levy introduced in 2002). In addition, a new tax on travelling by plane (air passenger duty) was introduced in 1993 and has been increased and restructured more recently. Company car taxes and the annual vehicle excise duty have both been restructured, with differential rates reflecting the different environmental attributes of vehicles. In London, a congestion charge for vehicle use in the central area was introduced in 2003.

Table 10.1 shows the revenues from the main environmentally related taxes in the UK in 2009–10. The vast majority of revenues come from taxes

[3] Newbery, 2003.
[4] OECD, 2006.

Table 10.1. Environmental tax revenues, 2009–10

Tax	Estimated revenue (£ billion)
Fuel duties	26.2
Vehicle excise duty	5.6
Climate change levy	0.7
Landfill tax	0.8
Aggregates levy	0.3
Air passenger duty	1.9
Total	35.5

Source: HM Treasury, 2010b, table C11; with additional information from http://budgetresponsibility.independent.gov.uk/wordpress/docs/hmrc_receipts_300610.pdf.

on motoring (which were not originally conceived as 'environmental' taxes). This is typical of OECD countries, though tax rates are higher than average in the UK. The small amount of revenue raised by the other taxes comes mostly from energy production and consumption.

When polluters take account only of the private costs of their activities, ignoring the social costs, they will pollute more than is socially efficient. Taxes change the prices faced by polluters and they change their behaviour in response. A tax on pollution emitted by firms during production allows firms with different business models and adjustment costs to react differently. Crucially, a tax encourages adjustments where they are most easily or cheaply enacted. Firms with lower adjustment costs will do more to reduce pollution than firms where costs are greater. This is efficient, whereas insisting that all firms do the same thing can be very costly.

In principle, we want to increase the tax on pollution until the marginal cost for the firm of emitting pollution is equal to the marginal environmental benefit of the additional abatement the tax induces. (This would not normally reduce pollution to zero, as the costs of abatement would typically outweigh the benefits since some polluting activities may be valuable.) In reality, we lack the information to achieve this optimal solution precisely. Taxes can easily be set too low or too high. Badly designed or excessive taxes can be damaging. As Fullerton, Leicester, and Smith (2010, 439–40) say,

> The key to achieving the potential gains from environmental taxes does not lie in the indiscriminate introduction of taxes with a vaguely defined environmental

justification. Rather, it lies in the effective targeting of incentives to the pollution or other environmental problems that policy seeks to influence. Poorly targeted environmental taxes may increase the economic costs of taxation, while offering little in the way of environmental gains.

This is illustrated by the different forms of environmental tax that are possible. Taxes on measured emissions can, in principle, be very closely targeted on environmental objectives. Swedish taxes on nitrogen oxide emissions and Dutch charges for water pollution are good examples. But the information requirements for such taxes can be quite severe, limiting their general applicability. Emissions are not generally measured or traded, so costly special mechanisms may need to be set up to allow them to be taxed. An alternative is to tax observable market transactions that are related to pollution—taxes on batteries or fertilizers might fall into this category. Administratively, such taxes may be much cheaper, but they are less directly targeted and they may prompt unintended or inefficient responses from polluters.[5]

Such concerns may lead one to prefer a *multi-part instrument*—a combination of taxes and/or subsidies which between them are easier to implement than a direct tax on emissions but avoid some of the adverse consequences of a simple tax on a market transaction. For example, an excise tax on the sale of a commodity and a subsidy for clean technology may be better together than either on its own. Similarly, taxing motor vehicle emissions directly may not be feasible, but the combination of a tax on petrol, a subsidy to new car purchases (or a tax on older cars), and a tax on cars with low fuel efficiency or high emission rates may together be broadly as effective.[6]

These practicalities in designing environmental taxes are crucial and all too frequently overlooked. The right tax structure will depend on circumstances. Taxing coal burned in power stations on the basis of its sulphur content would be a mistake because flue gas desulphurization is a viable and effective way to remove sulphur from emissions. There is no incentive to remove the sulphur if the input rather than the emission is taxed. But taxing fuels on the basis of their carbon content looks a much better bet—at least so long as

[5] Sandmo, 1976.

[6] Fullerton and West, 2002.

there are no viable technologies to remove carbon dioxide (CO_2) after combustion. This position may change as technology advances, so the tax structure must be dynamic and responsive to changes in technology and circumstances.

Note also the distinction between 'stock' and 'flow' pollutants. Flow pollutants cause damage as they are produced and the damage ends when their production ends. Emissions of nitrogen oxides and sulphur dioxide are like this—they cause health damage when emitted and the damage falls rapidly when the emissions stop. Carbon dioxide, on the other hand, is a classic stock pollutant—it is the stock of CO_2 (and other greenhouse gases) which causes global warming. Flow pollutants are easier to price, as all we need to know is the damage they do immediately. The damage done by stock pollutants builds up and can last over long periods. As we discuss in Chapter 11, in the case of greenhouse gases a large number of assumptions—for example, about future emissions, the consequences of those emissions, and how to value the welfare of future generations—may need to be made to set an appropriate price.

10.2. TAXES AND TRADING

In a world in which all benefits and costs are known for sure, any reduction in pollution can be achieved either by restricting the quantity of pollution or by increasing its price. The former can involve direct limits on polluters or allocating a limited number of pollution licences. The latter can involve a price on each unit of pollution or a tax on polluting activity. Whatever the method, the goal is to achieve the efficient level of pollution, where the cost to society of polluting slightly more or less is equal to the benefit of doing so.

How can this be achieved by quantity restriction? The government can use its knowledge of the costs and benefits directly to order firms to make the efficient level of adjustment or it can issue licences to the required overall quantity and allow them to be traded. Trading ensures that licences are ultimately used by the firms that most value the right to pollute, which is the most efficient outcome.

In a 'cap-and-trade' system, tradable emissions permits are allocated to polluting firms. Each permit allows the firm a certain quantity of emissions (pollution). What makes this different from direct regulation is allowing the firms to trade these permits. Firms with lower abatement costs will sell permits to firms with higher abatement costs. The need to buy a permit will raise the cost of polluting in much the same way as a tax, and an efficient trading system will achieve much the same outcome as a tax. Emissions will be reduced where it is cheapest and most efficient to do so. And, to labour the point, this is the beauty of the price mechanism.

Politicians and environmentalists sometimes argue that every sector of the economy should 'bear its fair share' of cutting (for example) carbon emissions—that more planes or cars or lorries are incompatible with concern about the environment. But the role of government should be to decide what costs it thinks emissions impose and, hence, what overall level it wants to achieve. Taxes or trading mechanisms can then achieve the most efficient allocation of reductions. If it then turns out that the most efficient way to reduce emissions across the economy is to cut emissions from cars to zero whilst emissions from planes continue to grow, or vice versa, then so be it.

Placing a tax upon a polluting activity, or allowing pollution only if a licence is held, produces an incentive to innovate over time, both by introducing new technology and by using available technologies more effectively. If a textile factory faces an increased cost of pouring chemicals into the river, it will look to find new ways of disposing of them or new ways of producing textiles without producing so many chemicals. A stronger effect can be achieved by announcing that quantity restrictions will become increasingly onerous over time. Such a strategy was particularly effective in encouraging innovation in the motor industry. For example, the adoption of regulations on vehicle emissions in California beginning in 1966 was at least partly responsible for the introduction of the catalytic converter in 1975.

Unlike regulation, environmental taxes also raise revenue. In the case of 'cap-and-trade', the same level of revenue can be raised by selling—generally auctioning—the initial allowances. While most policies to reduce pollution increase people's welfare by doing so, they also impose costs on consumers by increasing the price of the goods on whose production regulations or taxes have been imposed. If the government restricts pollution without raising revenue (which it can then recycle), it risks losing much of the

welfare gain associated with improved environmental performance through other costs imposed on consumers.

'Grandfathering' pollution permits—giving them free to polluting firms which can then trade them—will have the same impact on the total level of pollution and the distribution of polluting activities as auctioning them. Introducing pollution permits encourages firms to produce less, because the firms have to pay for them or because they can sell those they have already been allocated rather than undertake the production the permits would allow. In fact, grandfathering is equivalent to the case where permits are auctioned, but with the revenues given back to firms as lump-sum transfers. Firms are required to restrict output and pure 'windfall' profits arise. If permits are auctioned, then the government can capture these economic rents and use them to compensate consumers for higher costs or to reduce other distortionary taxes. With grandfathered permits, the economic rents are captured by producers. This was what happened—apparently to the surprise of some governments—when the EU's Emissions Trading Scheme was introduced.

We have so far emphasized situations in which taxes and cap-and-trade are equivalent. But when there is uncertainty over abatement costs, this equivalence is lost. The most salient difference is that cap-and-trade systems provide certainty over the amount of pollutant that will be emitted, whereas tax systems provide certainty for emitters over the costs they will face.

In principle, taxes are preferable where the benefits of reductions change less with the level of pollution than do the costs of delivering the reductions. Conversely, quantity mechanisms are preferable where the benefits of further reductions increase more with the level of pollution than do the costs of delivering reductions.[7] If there is significant uncertainty over the costs of delivering a particular level of emissions reductions, then cap-and-trade may impose higher costs than intended. But if we are concerned by risks to welfare arising from higher-than-intended emissions, then a quantity cap may be preferable to a tax since it can guarantee emissions falling to the desired level. In practice, the relative costs may be hard to determine and, in most circumstances, the choice between price and quantity intervention is

[7] Weitzman, 1974.

likely to be determined as much by practical and political considerations as by a clear understanding of the relative risks involved.

In fact, a combination of price and quantity regulation may perform better under uncertainty than reliance on just one or the other.[8] This might involve an emissions trading system with upper and lower 'safety valves'. At a high price the authorities might issue additional permits, while at a low price they would buy back permits. Alternatively, an emissions tax could be used to set a floor to the marginal incentive for abatement.

Such considerations do matter—cap-and-trade systems are now a popular policy tool. As well as being at the centre of the Kyoto climate change programme, they are in common use in fisheries management and have increasingly been used to control other forms of atmospheric pollution, most notably sulphur emissions in the US.

Taxes and cap-and-trade systems have many virtues, but there are still circumstances in which 'old-fashioned' regulation of behaviour will be more appropriate. Taxes may be difficult to implement or ineffective where pollution damage varies with the source of the emissions. If emission of some gases is much more damaging when close to large population centres, or discharging effluent is much more damaging in some stretches of water than in others, then, while very complex tax or trading structures could be designed, direct regulation is likely to be more efficient and effective. We might also worry that taxing or charging industries that are competing internationally might encourage some to move abroad. In that case, international agreements are likely to be necessary. This risk can be real but should not be overplayed. In addressing climate change, for example, large increases in energy prices are likely to impact significantly on location choices for only a small proportion of industries—cement manufacture and oil refining, for example.

Finally, and crucially, price signals do not work in all circumstances. Where individuals or firms are 'locked in' to particular technologies, imposing a tax may simply make them worse off. There may be other market failures that mean that incentives do not feed through to behaviour change. For example, there may be market failures in the rental market, where it may

[8] Roberts and Spence, 1976.

not be in the interest of a landlord to invest in better insulation if it is the tenant who pays the heating bills. For owner-occupiers, payback periods for substantial investments—for example, solid wall insulation—may be longer than their expected occupancy of the property and they may not believe that their investment will be reflected in the price they can get for the property when they come to sell it. It may also be difficult to persuade firms that the price imposed by a tax or trading system will be maintained. Investments by energy producers, for example, are very long lived and a lack of certainty over future policy may significantly reduce the effectiveness of price signals.

Whilst policymakers should be very careful in the choice of policy instrument, it *is* clear that there are areas where regulation, subsidy, or other intervention will be optimal alongside or instead of taxes or trading. In most areas where environmental taxes are beneficial, other forms of intervention can also be effective.

10.3. REVENUES AND THE DOUBLE DIVIDEND

Advocates of environmental taxes often argue that there is a 'double dividend' to be had by raising revenue from taxing pollution. The idea is straightforward and initially seductive: environmental taxes increase welfare *both* by reducing socially damaging activities *and* by reducing the need to raise tax revenues in other welfare-reducing ways. For example, environmental tax revenues can be used to pay for cuts in taxes on labour income which harm work incentives.

There are in fact many reasons to reject this view of a double dividend. But before we discuss them, bear in mind that the double dividend is not necessary for taxes on pollution to be welfare improving. The single dividend—the reduction in levels of pollution towards socially optimal levels—should be enough for that.

The intuition for the existence of a double dividend looks appealing, so what is wrong with it? The problem is similar to the incorrect argument that taxes on income reduce work incentives while taxes on spending do not. Because taxes on spending reduce the real buying power of wages, they have a similar incentive effect to labour income taxes. Similarly, environmental

taxes tend to increase the price of goods consumed somewhere in the economy and so will have distortionary effects of their own. These effects may be bigger or smaller than the welfare effects of any taxes that are cut in response to the increased revenues from the environmental taxes. For a double dividend to exist in this sense, there would need to be 'no regrets' even if the expected environmental benefits did not arise.

Now, it might be the case that the current tax system is suboptimal in other ways—that goods with negative spillovers are not taxed highly enough (even ignoring the pollution consequences) and that other taxes are too high. In that case, raising taxes on the polluting activity *would* provide a double dividend, but only because of the original poor design of the tax system. The opposite case is also possible. Raising environmental taxes on goods or activities that are currently overtaxed will tend to reduce welfare, i.e. even part of the single dividend will be lost.

From the UK perspective, for example, there is one major potential environmental tax proposal which could unlock more than a single dividend because the current structure is suboptimal even ignoring environmental questions. Currently, the UK does not charge the full rate of VAT on domestic energy use, which an optimal system would do[9] *even ignoring effects on carbon emissions*. So raising tax on domestic energy might well involve a double dividend. We would move the tax system towards an optimal structure and (ignoring for the moment the complicating issue of the impact of the EU's Emissions Trading Scheme) also cut carbon emissions towards optimal levels. Even here, though, we would most likely accompany the increased tax with some form of compensation package which, if not designed carefully in the way we illustrated in Chapter 9, could itself worsen work incentives and dampen the overall welfare gain.

This argument underlines how important it is to look at the tax system as a whole when thinking about the effects and appropriate design of new taxes. The revenue raised from environmental taxes (or auctioned allowances) does allow other taxes to be cut, which provides an additional welfare gain alongside the environmental gains. But the double dividend argument overstates what is an already strong argument by ignoring the potential

[9] See Chapters 6, 7, and 9.

welfare *costs* of environmental taxes, which tax cuts elsewhere may or may not offset.

10.4. SOME PRACTICAL POLICY

We consider the implications of the principles we have discussed for policy towards climate change and motoring in the next two chapters. Actual and potential taxes on motoring, and potential taxes on energy use, are more substantial by far than any other existing or currently feasible environmental tax. The other relevant taxes in the UK are air passenger duty, the landfill tax, and the aggregates levy. Each of these smaller taxes is interesting in its own right.

Air passenger duty (APD) was first introduced in the November 1993 Budget. Since then, the rates at which it is levied have been increased, cut, increased again, and restructured. Expected to raise £2.3 billion in 2010–11,[10] it is charged on a per-person-per-flight basis, varying according to the class of ticket and according to whether the destination is more or less than 2,000 miles from London. Several features are noteworthy:

- First, despite its relatively recent origin, it was not introduced as an explicitly environmental tax, but rather because air travel was seen as undertaxed relative to other sectors thanks to its zero-rating for VAT. Indeed, Treasury ministers continue, at times, to argue that it is not essentially an environmental tax.[11]
- Second, most of the externalities associated with flying—noise and greenhouse gas emissions—are more closely related to the number of flights and the characteristics of the planes than to the number of people

[10] Source: HM Treasury, 2010b, table C11.

[11] John Healey, then Financial Secretary to the Treasury, argued that '[APD] has never been an environmental tax.… it does, however, contribute to the recognition that … the aviation industry has to pay the costs, the externalities if you like, that it imposes on society and on the environment' (House of Commons Environmental Audit Committee, 2006, Q185 on Ev 73).

on board the planes. So APD is levied on only a very rough proxy for the relevant externality.

- Third, continued zero-rating of domestic aviation for VAT looks very odd in the face of concerns about environmental impacts.

The even smaller landfill tax is also interesting in terms of looking at how policy can actually develop. Research on the external costs of disposing of waste in landfill[12] was used to justify a tax rate on 'standard' waste of £7 a tonne and a reduced rate for 'inactive' waste of £2 a tonne from October 1996. But since then the standard tax rate has been increased time and again, reaching £40 a tonne in 2009 and due to increase to £80 a tonne by 2014. This is several times greater than any reasonable estimate of the external costs associated with landfill. Brought in originally as a tax with a rate set at something close to the best estimates of the external cost it was intended to internalize, the landfill tax has been forced up to levels that may be economically hard to justify, in an attempt to meet externally imposed targets set under the 1999 European Landfill Directive. To help meet those targets, the Landfill Allowance Trading Scheme (LATS) has also been introduced. This allocates a landfill tonnage (for biodegradable municipal waste) to each local authority in England up to 2020.

A number of issues arise from this example. Precise and effective targeting is difficult, and damaging avoidance behaviour is a possibility. The government acknowledges that 'there is some evidence that rising costs of legitimate disposal, including landfill sites, can lead to increases in flytipping'.[13] In addition, price signals may be rather ineffective in changing behaviour here. The biggest payers are local authorities disposing of household waste, but they are not able to charge households. So while councils have an incentive to find other methods of disposal, there is no price signal for households that might lead to any change in their behaviour. Using two instruments in this way also means that one is effectively redundant. Given that the LATS places a binding cap on landfill (or biodegradable municipal waste), the tax plays no role in reducing landfill. In addition, the high tax levels and the quantity cap have been imposed to meet

[12] CSERGE, 1993.

[13] http://archive.defra.gov.uk/environment/quality/local/flytipping/flycapture-qa.htm.

given targets, rather than because the tax rates have been economically justified by the environmental damage associated with landfill.

For completeness, we should also mention the aggregates levy, which was introduced in 2002 explicitly to address the environmental externalities associated with the commercial exploitation of aggregates. Companies subject to the levy were granted a reduction in National Insurance contributions to make the policy revenue neutral. To some extent, the levy has been successful. The use of recycled aggregates has risen from an estimated level of 10 million tonnes per year in 1990 to 36 million tonnes in 2003.[14] On the downside, there has been an increase in illicit quarrying.

A more general lesson from environmental taxes internationally is that it is extraordinarily hard, *ex ante*, to know what effects taxes at different levels will have. Leaving scope for evaluation and experimentation is important.

What of possible new environmental taxes or permit regimes? Leading contenders in the UK include reform of licences for abstraction of water and discharging of waste water. Currently, such licences are provided in a way that covers administration costs but that does not reflect either scarcity value or environmental costs and that does not facilitate trading. There is scope to use price signals and trading so that decisions do incorporate economic and environmental costs.[15]

The introduction of a plastic bags tax, as in Ireland, is another contender. The Irish experience suggests that such a tax, introduced there at €0.15 a bag, can be effective at influencing behaviour. The tax is estimated to have reduced plastic bag use by more than 90%—and as a result, of course, it has raised minimal revenue. It has involved some unintended consequences—including an increase in theft of baskets and trolleys—and its overall environmental impact has probably been small.[16] But it certainly indicates the scope for pricing to change behaviour in quite dramatic ways.

It is beyond the scope of this review to consider these or numerous other possible taxes in more detail. Experience internationally has been mixed. Certainly—outside of energy and transport—there seems little scope for raising large sums of money. Some schemes have had positive effects, but

[14] British Aggregates Association, 2005.

[15] See the Cave Review (Cave, 2009).

[16] Convery, McDonnell, and Ferreira, 2007.

most are quite costly to run and some have been driven more by political than by economic considerations.

10.5. CONCLUSIONS

The case for using taxes or cap-and-trade mechanisms to counter environmental externalities is strong. Using the price mechanism in this way can lead to firms and consumers internalizing the costs they are imposing on others and can result in a more efficient outcome than regulation. The government can use the revenues that arise to reduce the distortionary effects of other taxes. While this need not give rise to a 'double dividend', the welfare gain associated with efficient reduction of the externality justifies the tax.

The choice between taxes and cap-and-trade is not straightforward. In principle, they can achieve the same outcome, so long as permits are auctioned in the cap-and-trade case so that the government captures the rents created. When there is uncertainty about abatement costs, the case for a tax may be stronger if there is a risk that the costs of achieving a particular level of abatement may be very high. The case for cap-and-trade is stronger if the costs of not meeting a particular level of abatement are high. A hybrid system that places a floor and/or ceiling on prices in a cap-and-trade system may have particular attractions in these circumstances.

The precise design of the tax or trading scheme, and how it sits alongside other environmental policy, is important. Getting the price or quantity 'right' is likely to be difficult and to require a degree of experimentation. There will be cases where the existence of other market failures requires the use of instruments other than taxes.

While a role for more environmental taxation undoubtedly exists, it is not a magic bullet that will either transform the tax system or sort out all environmental problems by itself. The principles that have guided other elements of our conclusions are certainly relevant here. Complicating the tax system is easy in this area. There are undoubtedly gains to be had from this complication, but there are costs too—both immediate compliance and administrative costs and longer-term costs in lobbying and special pleading.

Whilst the UK government has been good at setting out aspirations and principles, it remains a pity that no serious, comprehensive, and public review and analysis of the potential options in this area have been undertaken.

We move on to consider the two biggest areas of environmental taxation in practice in the next two chapters, on climate change and on motoring.