14 Harnessing Markets for Mitigation – the role of taxation and trading

Key Messages

- **Agreeing a quantitative global stabilisation target range for the stock of greenhouse gases (GHGs) in the atmosphere is an important and useful foundation for overall policy.** It is an efficient way to control the **risk** of catastrophic climate change in the long term. Short term policies to achieve emissions reductions will need to be consistent with this long-term stabilisation goal.

- **In the short term, using price-driven instruments (through tax or trading) will allow flexibility in how, where and when emission reductions are made, providing opportunities and incentives to keep down the cost of mitigation.** The price signal should reflect the marginal damage caused by emissions, and rise over time to reflect the increasing damages as the stock of GHGs grows. For efficiency, it should be common across sectors and countries.

- **In theory, taxes or tradable quotas could establish this common price signal across countries and sectors.** There can also be a role for regulation in setting an implicit price where market-based mechanisms alone prove ineffective. In practice, tradable quota systems – such as the EU's emissions-trading scheme – may be the most straightforward way of establishing a common price signal across countries. To promote cost-effectiveness, they also need flexibility in the timing of emissions reductions.

- **Both taxes and tradable quotas have the potential to raise public revenues.** In the case of tradable quotas, this will occur only if some firms pay for allowances (through an auction or sale). Over time, there are good economic reasons for moving towards greater use of auctioning, though the transition must be carefully managed to ensure a robust revenue base.

- **The global distributional impact of climate-change policy is also critical.** Issues of equity are likely to be central to securing agreement on the way forward. Under the existing Kyoto protocol, participating developed countries have agreed binding commitments to reduce emissions. Within such a system, company-level trading schemes such as the EU ETS, which allow emission reductions to be made in the most cost-effective **location** – either within the EU, or elsewhere – can then drive financial flows between countries and promote, in an equitable way, accelerated mitigation in developing countries.

- At the **national – or regional** – level, governments will want to choose a policy framework that is suited to their specific circumstances. Tax policy, tradable quotas and regulation can all play a role. In practice, some administrations are likely to place greater emphasis on trading, others on taxation and possibly some on regulation.

14.1 Introduction

This chapter focuses on the first and key element of a mitigation strategy – how best to ensure GHG emissions are priced to reflect the damage they cause.

This chapter focuses on the principles of policy and, in particular, on the efficiency, equity and public finance implications of tax and tradable quotas. Chapter 15 follows with a detailed discussion of the practical issues associated with the implementation of tax and trading schemes.

Section 14.2 begins by setting out the basic theory of externalities as this applies to climate change. Based on this, Section 14.3 sets out two overarching principles for reducing GHG emissions efficiently. First, abatement should occur just up to the point where the costs of going any further would outweigh the extra benefits. Second, a common price signal is needed across countries and sectors to ensure that emission reductions are delivered in the most cost-effective way.

Section 14.4 explores the policy implications of the significant risks and uncertainties surrounding both the impacts of climate change, and the costs of abatement. It concludes that a long-term quantity ceiling – or stabilisation target – should be used to limit the total stock of GHGs in the atmosphere. In the short term, to keep down the costs of mitigation, the amount of abatement should be driven by a common price signal across countries and sectors, and there should be flexibility in how, where and when reductions are made. Over time, the price signal should trend upwards, as the social cost of carbon is likely to increase as concentrations rise towards the long-term stabilisation goal.

These sections conclude that both taxes and tradable quotas have the potential to deliver emission reductions efficiently. The other key dimensions of climate change policy – tackling market failures that limit the development low carbon technologies, and removing barriers to behavioural change are discussed in are discussed in Chapter 16 and Chapter 17 respectively.

The penultimate section of the chapter considers the public-finance aspects of taxes and tradable quotas. Finally, Section 14.8 briefly considers the international dimension of carbon-pricing policy. These international issues are treated in greater depth in Part VI of this Review – in particular, the challenge of how national action can be co-ordinated and linked at the international level to support the achievement of a long-run stabilisation goal is considered in Chapter 22.

14.2 Designing policy to reduce the impact of the greenhouse-gas externality

As described in Chapter 2, the climate change problem is an international and intergenerational issue.

Climate change is a far more complicated negative externality than, for example, pollution (such as smog) or congestion (such as traffic jams). Key features of the greenhouse-gas externality are:

- it is a global externality, as the damage from emissions is broadly the same regardless of where they are emitted, but the impacts are likely to fall very unevenly around the world;
- its impacts are not immediately tangible, but are likely to be felt some way into the future. There are significant differences in the short-run and long-run implications of greenhouse-gas emissions. It is the stock of carbon in the atmosphere that drives climate change, rather than the annual flow of emissions. Once released, carbon dioxide remains in the atmosphere for up to 100 years;
- there is uncertainty around the scale and timing of the impacts and about when irreversible damage from emission concentrations will occur;
- the effects are potentially on a massive scale.

These characteristics have implications for the most appropriate policy response to climate change. In the standard theory of externalities[1], there are four ways in which negative externalities can be approached:

- a tax can be introduced so that emitters face the full social cost of their emissions[2] ie. a carbon price can be established that reflects the damage caused by emissions;
- quantity restrictions can limit the volume of emissions, using a 'command and control' approach;

[1] Developed mainly in the first half of the last century.
[2] Pigou (1920) showed how taxes can establish a marginal cost to polluters equal to the marginal damage caused by their pollution.

- a full set of property rights can be allocated among those causing the externality and / or those are affected (in this case including future generations), which can underpin bargaining or trading[3];
- a single organisation can be created which brings those causing the externality together with all those affected[4].

In practice, cap-and-trade systems tend to combine aspects of the second and third approach above. They control the overall quantity of emissions, by establishing binding emissions commitments. Within this quantity ceiling, entities covered by the scheme – such as firms, countries or individuals – are then free to choose how best – and where – to deliver emission reductions within the scheme. The largest example of a cap-and-trade scheme for GHG emissions is the EU's Emissions Trading Scheme, and there are a range of other national or regional emissions trading schemes, including the US Regional Greenhouse Gas Initiative and the Chicago Climate Exchange.

The Kyoto Protocol established intergovernmental emissions trading for those countries that took quantified commitments to reduce GHG emissions, as well as other mechanisms to increase the flexibility of trading across all Parties to the Protocol. The Kyoto Protocol and its flexible mechanisms are discussed in detail in Chapter 22.

Whatever approach is taken, the key aim of climate-change policy should be to ensure that those generating GHGs, wherever they may be, face a marginal cost of emissions that reflects the damage they cause. This encourages emitters to invest in alternative, low-carbon technologies, and consumers of GHG-intensive goods and services to change their spending patterns in response to the increase in relative prices.

14.3 Delivering carbon reductions efficiently

Where markets are well functioning, two conditions must hold to reduce GHG emissions efficiently[5]:

- Abatement should take place up to the point where the benefits of further emission reductions are just balanced by the costs. Or – put another way – abatement should occur up to the point where the marginal social cost of carbon is equal to the marginal cost of abatement. This is a necessary condition for choosing the appropriate level of emissions, and hence setting a long-term stabilisation target (and is explained fully in Chapter 13).

- To deliver reductions at least cost, a common price signal is required across countries and different sectors of their economies at a given point in time. For example, if the marginal cost of reduction is lower in country A than in country B, then abatement costs could be reduced by doing a little more reduction in country A, and a little less in country B.

In ideal conditions – perfectly competitive markets, perfect information and certainty, and no transaction costs – both taxes and quantity controls, if correctly designed, can meet these criteria, and be used to establish a common price signal across countries and sectors. Taxes can set the global price of greenhouse gases, and emitters can then choose how much to emit. Alternatively, a total quota (or ceiling) for global emissions can be set and tradable quotas can then determine market prices.[6]

Without market imperfections and uncertainty, and with an appropriate specification of taxes and quotas (entailing an allocation of property rights), both approaches would produce the

[3] Coase (1960)
[4] Meade (1951). This is not discussed further, as it is clearly not a practical option in relation to climate change.
[5] These conditions abstract from uncertainty and market imperfections.
[6] Continuous trading is necessary to ensure a common price between auctions/ allocations.

same price level and quantity of emissions[7]. The remainder of this chapter, and Chapter 15, consider how the considerable uncertainties and imperfections that exist in the real world affect the choice and design of policy.

14.4 Efficiency under uncertainty – the implications for climate-change policy

Substantial uncertainty exists around the timing and scale of impacts, as well as the costs of abatement. In such circumstances, prices and quantity controls are no longer equivalent and policy instruments will need to be chosen with care to reduce GHG emissions efficiently.

Weitzman (1974) examined how price (here tax) and quota or quantity-control instruments compare where there is uncertainty about the costs and benefits of action, and how this affects the comparative efficiency of the two instruments[8]. A price instrument sets a price for a required service or good and lets markets determine its supply. In contrast, a quota instrument specifies a particular level of supply. Applying the Weitzman analysis to pollution:

- Prices are preferable where the benefits of making further reductions in pollution change less with the level of pollution than do the costs of delivering these reductions i.e. when the marginal damage curve – or the marginal social cost of carbon - is relatively flat, compared with the marginal abatement cost curve, as pollution rises.
- Quantity controls are preferable where the benefits of further reductions increase more with the level of pollution than do the costs of delivering these reductions i.e. there are potentially large and sharply rising costs associated with exceeding a given level of pollution.

Box 14.1 sets out these economic arguments in detail[9].

Box 14.1 Prices versus quantities in the short term and long term.

Figure (A) illustrates how Weitzman's analysis is applied in the climate-change case. If the emissions reductions are measured over a short period, say a year, the expected marginal benefits of abatement are flat or gently decreasing as the quantity of emission reduction increases (from left to right). This reflects the fact that variations in emissions in any single year are unlikely to have a significant effect on the ultimate stock of greenhouse gases. The expected marginal costs of abatement (MAC_E), however, are steeply increasing as abatement activity intensifies; firms find it progressively more difficult to reduce emissions, unless they can adjust their capital stock and choice of technology (assumed by definition to be impossible in the short term).

If it were known with certainty that the marginal costs of abatement were given by the schedule MAC_E, the policy-maker should set the rate of the emission tax to equal T_E, given by the intersection of the schedule with the marginal benefits of abatement, also assumed to be known. The optimal quantity of emission quotas or allowances allocated (Q_E) would also be given by this intersection, giving rise to an equilibrium price in a perfectly competitive allowance market of P_E. The choice of quota or tax would not matter in this case.

However, following the exposition in Hepburn (2006), suppose that the real marginal costs of abatement in the period are not known with certainty in advance and turn out to be higher at every point, as represented by the curve MAC_{REAL}, and that the policy-maker cannot adjust the policy instrument in anticipation. In this case, the optimal quantity of allowances to be allocated would in fact turn out to have been Q_{REAL}. In Figure 14.1, the efficiency loss caused by issuing Q_E instead of Q_{REAL} allowances is given by the large blue triangle. If instead a tax had been set at T_E, the efficiency loss resulting from having set a slightly lower

[7] But it is worth noting that even if these ideal conditions were to hold, the nature of the climate-change problem means there are limitations to the applicability of some of the policy options set out above. In particular, a **full set** of property rights cannot be allocated, because many of those affected by the impacts of climate change are yet to be born. It is not possible for them to bargain with the current emitters for the impacts they will have to endure.
[8] Weitzman (1974)
[9] This box draws on the exposition in Hepburn (2006).

tax rate than turns out to have been warranted is given by the small red triangle. Thus it is often argued that a tax is superior to a quota as an instrument of climate-change policy[10] in the short run. As Chapter 2 explains, however, diagrams like that in Figure (A) need to be interpreted with great care, as the positions of both the curves may depend on policy settings in earlier and later periods.

(A) The efficiency of taxes and tradable allowances in climate-change mitigation in the short term.

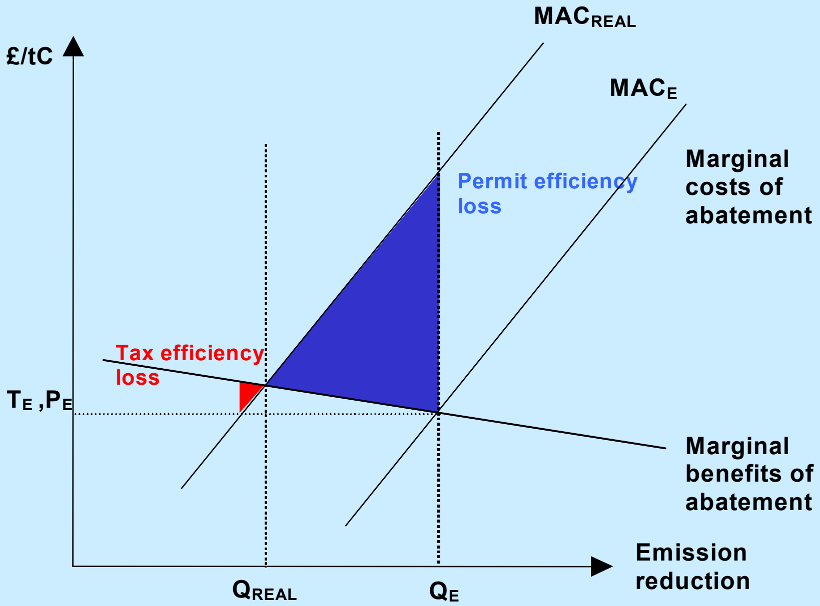
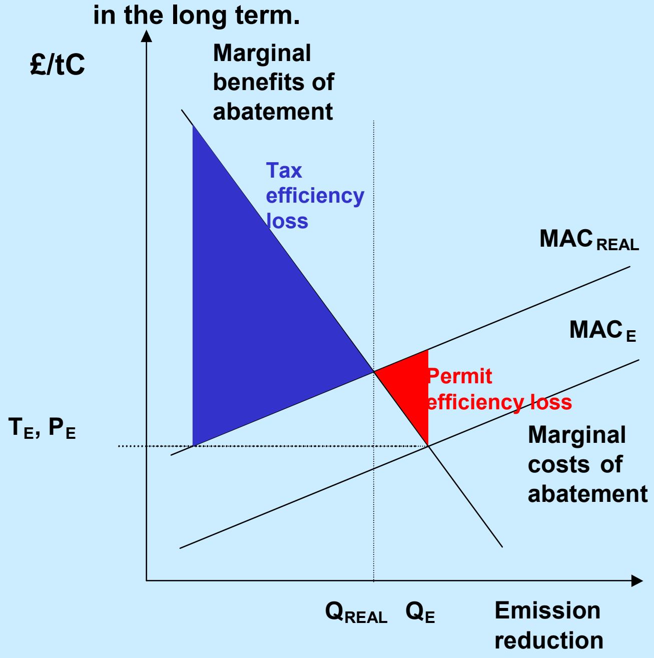


Figure (B) illustrates the situation in the long term, with the cumulative emissions reductions required to reach the ultimate stabilisation target on the x-axis now, instead of annual emissions reductions as in Figure (A). The curve representing the marginal benefits of abatement is steeply decreasing, as more and more abatement effort is put in (put another way, the costs of the impacts of climate change increase steeply as cumulative emissions increase). But the marginal costs of abatement are only gently increasing as a function of abatement effort, since in the long run there is more flexibility. In the certainty case with MAC_E as the true cost of abatement curve, Q_E is the appropriate cumulative quota, while T_E is the equivalent tax[11]. But if MAC_E represents the expected costs of abatement and MAC_{REAL} the higher ex post actual costs, the efficiency loss implied by setting the tax at T_E (the blue triangle) is now much larger than that implied by setting the quantity of tradable allowances at Q_E. Of course, if the policy-maker is able to revise the tax or quota schedule as information comes in about the marginal abatement costs function, s/he can do better than keeping either schedule fixed.

[10] The direct allocation of non-tradable allowances requires information about relative costs across firms, as well as total costs, and so is likely to be even less efficient, given the uncertainties in the real world, than promoting perfect competition in the market for allowances.
[11] Strictly, there is an intertemporal tax schedule that generates cumulative emissions reductions Q_E

(B) The efficiency of taxes and tradable allowances in climate-change mitigation in the long term.



This contrast between short-term and long-term marginal cost and marginal benefit curves gives rise to the problem of how to combine a tax-like regime in the short term with a quantitative constraint in the long term. A rule is needed for updating the tax in the light of new information about costs over the long term and the ex post quantity of emissions.

In the case of climate change, these arguments indicate that the most efficient instrument – over a particular time horizon – will depend on:

- how the total costs of abatement change with the level of emissions;
- how the total benefits of abatement change with the level of emissions;
- the degree of uncertainty about both costs and benefits of abatement.

Chapter 8 explains that it is the total stock of GHGs in the atmosphere that drives the damage from climate change. In economic terms, this means that the marginal damage associated with emitting one more unit of carbon is likely to be more or less constant over short periods of time. Thus, in the short-term, the marginal damage curve is likely to be fairly flat. But over the long term, as the stock of GHGs grows, marginal damages are likely to rise and – as the stock reaches critical levels – marginal damages may rise sharply. In other words, the damage function is likely to be strongly convex (as discussed in Part Two and Chapter 13)[12].

On the other side of the equation, many uncertainties remain about the marginal costs of abatement. Many new technologies that could be used to reduce carbon emissions are not yet in widespread use. Trying to abate rapidly in the short term – when the capital in industries emitting greenhouse gases is fixed and technologies are given – can quickly become costly for firms, as the marginal cost of abatement is likely to rise sharply[13]. In particular, if the costs of abatement prove to be unexpectedly high, then setting a fixed quantity target in the short term could prove unexpectedly costly. Over the long term – as the capital stock is replaced and new lower-carbon technologies become available – the

[12] To the extent that damages may relate to the *rate* of climate change, the relationship is more complex, but it remains true that the damage curve is likely to respond most to cumulative emissions over several years or even decades.
[13] For a discussion of the relative abatement costs and marginal benefits of climate change see, for example, Lydon (2002) and Pizer (2002). Both conclude that the marginal damage curve is relatively flat – at least in the short term – and, as such, there are strong arguments for flexibility in the quantity of abatement in the short term, subject to a fixed carbon price.

marginal costs of abating in the long term are likely to be broadly flat, or, put another way, bounded relative to incomes. The implications are explained more fully in Box 14.1.

These characteristics of the costs and benefits of abatement and damage from emissions suggest three things:

- Policy instruments should distinguish between the short term and long term, ensuring that short-term policy outcomes are consistent with achieving long-term goals[14];
- The policy-maker should have a clear long-term goal for stabilising concentrations of greenhouse gases in the atmosphere. This reflects, first, the likelihood that marginal damages (relative to incomes) will accelerate as cumulative emissions rise and, second, that the marginal costs of abatement (relative to incomes) are likely to be relatively flat in the long term once new technologies are available.
- In the short term, the policy-maker will want to choose a flexible approach[15] to achieving this long-term goal, reflecting the likelihood that marginal damages will be more or less constant, and there will be risks of sharply rising costs from forcing abatement too rapidly.

In practical terms, this means that a long-term stabilisation target should be used to establish a quantity ceiling to limit the total stock of carbon over time. Short-term policies (based on tax, trading or in some circumstances regulation) will then need to be consistent with this long-term stabilisation goal. In the short term, the amount of abatement should be driven by a common price signal across countries and sectors, and should not be rigidly fixed[16].

This common price signal could – in principle – be delivered through taxation or tradable quotas. A country can levy taxes without consultation with another, but harmonisation requires agreement. In practice, therefore, it may prove difficult to use taxes to deliver a common price signal in the absence of political commitment to move towards a harmonised carbon tax across different countries. In contrast, to the extent that a tradable quota scheme embraces both different countries and sectors, it may be an effective way of delivering a consistent price signal across a wide area – though this, of course, requires agreement on the mechanics of the scheme. International co-ordination issues are fully discussed in Chapter 22 – here it is sufficient to note that building consensus on the best way forward will be critical to achieving a long-run stabilisation goal.

14.5 Setting short term policies to meet the long term goal

The key question that arises from the previous section is how to combine a price instrument that allows flexibility about where, when and what emissions are reduced in the short term, with a long-term quantity constraint. In particular, the challenge is how to ensure that the short-term policy framework remains on track to deliver the long-term stabilisation goal.

There are two important aspects to this:

- having established the long-term stabilisation goal, the price of carbon is likely to rise over time, because the damage caused by further emissions at the margin-the social cost of carbon- is likely to increase as concentrations rise towards this agreed long-term quantity constraint;

- short-term tax or trading policies will then need to be consistent with delivering this long-term quantitative goal.

In the short-term, applying these principles to tax and trading, this means that:

[14] The short term is defined as the period during which the capital stock is essentially fixed. This will vary from sector to sector.
[15] With respect to the size of emission reductions.
[16] One option is to combine price controls within a quota trading system in the short term. This is discussed more in Chapter 15.

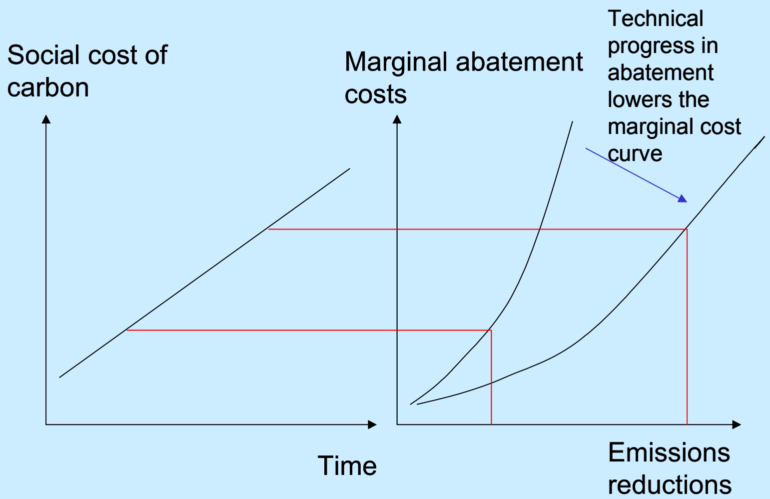
- In a tax-based regime, the tax should be set to reflect the marginal damage caused by emissions. Abatement should then occur up to the point where the marginal cost of abatement is equal to this tax. See Box 14.2.

- In a tradable-quota scheme, the parameters of the scheme – notably the total quota allocation – should be set with a view to generating a market price that is consistent with the social cost of carbon (SCC). In practice – and within the time period between allocations in a tradable-quota system – the market price may be higher or lower than the SCC. This is because the actual market price will reflect both the quota-driven demand for carbon reductions and the marginal cost of delivering reductions in the most cost-effective location. Ex-post, the trading period will therefore deliver abatement up to where the marginal abatement cost equals the actual market price.

In the case of either tax or trading, clear revision rules are therefore necessary to ensure that short-term policies remain on track to meet the long-term stabilisation goal. In particular, the short-term policy framework should be able to take systematic account of the latest scientific information on climate change, as well as improved understanding of abatement costs.

The framework within which any principles for revisions apply must be clear, credible, predictable and set over long time horizons, say 20 years, with regular points, say every five years, to review new evidence, analysis and information[17]. Chapter 22 discusses the challenge of achieving this at an international level.

Box 14.2: The social cost of carbon and the carbon price



Up to the long-term stabilisation goal, the social cost of carbon will rise over time, because marginal damage costs also rise. This is because atmospheric concentrations are expected to rise, so that temperatures are likely to rise; marginal damage costs are expected to rise with temperature. These effects are assumed to outweigh the declining marginal impact of the stock of gases on global temperature at higher temperatures.

As GHG concentrations move towards the stabilisation goal, the price of carbon should reflect the social cost of carbon. In any given year, abatement should then occur up to where the marginal cost is equal to this price, as set out in the right-hand part of the diagram above. If, over time, technical progress reduces the marginal cost of abatement, then at any given price level there should be more emission reductions.

Revision rules for climate-change policies can be compared to setting interest rates within a well-specified inflation-targeting regime[18]. The stabilisation target is analogous to the inflation

[17] Newell et al (2005)
[18] This analogy has been explored by Helm et al (2005).

target. In the UK, the Monetary Policy Committee each month sets a short-term policy instrument, the interest rate on central-bank money, until their next meeting, in order to keep inflation on track to hit its target. The analogy with climate-change policy would be the setting of a tax rate or an emissions trading quota for, say, a five year period, with firms and households making their own decisions about emissions reductions subject to that carbon-price path and their expectations about policy-makers' commitment to the long-term stabilisation goal.

The analogy is not, however, exact.First, there is widespread agreement about the appropriate long-term goal for monetary policy – price stability, whichcorresponds to a small positive measured inflation rate. In the climate-change case, there is not yet agreement about the stabilisation level at which that stability should be achieved, Second, the stabilisation objective is likely to have to be revised intermittently – possibly by a large amount – to reflect improved scientific and economic understanding of the climate-change problem, whereas the definition of price stability in terms of a specific inflation measure is less problematic.And third, the locus of decision-making in monetary policy clearly lies with the monetary authority of the country for which the inflation rate is measured, whereas climate change requires international collective action.

Nevertheless, the comparison with an inflation-targeting regime draws attention to the importance of building the credibility of policy-makers. This requires clarity about the ultimate objective of policy and giving policy-makers control over an instrument that can change private-sector behaviour. It also means announcing the principles governing changes in the policy instrument in advance, giving policy-makers incentives to keep aiming at the ultimate target, and holding policy-makers accountable for their actions.

14.6 The interaction between carbon pricing and fossil fuel markets

Imperfections in the markets for exhaustible resources and energy could have important interactions with carbon-pricing policy that should also be considered.

Carbon emissions come from energy production and use across various sectors (see Chapter 7). Much of this energy is generated using exhaustible resources such as oil. In the face of climate change policy, the owners of the natural resource may be willing to reduce producer prices substantially in order to sell off the commodity before it becomes obsolete or of a much lower value. Thus any carbon-pricing policy would need to be carefully designed to ensure it does not accelerate the pace with which carbon-intensive exhaustible resources are used up. The policy implications of this – as well as market imperfections more generally – are explored in Box 14.3.

Box 14.3 Efficiency market structure and exhaustible resources

Energy and related markets have pervasive market imperfections that will affect the efficiency of a given policy instrument[19]. For example, the collusive behaviour of the OPEC cartel can make it difficult to predict what the final impact on market prices will be from either a tax or a quota-driven carbon price. Thus, on the one hand, OPEC might respond to a carbon tax by further restricting supply, pushing up producer prices and retaining most of their rents. On the other hand, they may choose to retain market share and extract a lower rent[20] with little change in carbon emissions[21].

Where the input prices concerned relate to fossil fuels, the policy must also take account of the fact that such fuels are exhaustible natural resources. Prices to consumers will reflect both the marginal costs of extraction and a scarcity rent (which reflects the stock of the natural resource relative to the expected demand schedule over time). In these circumstances, attempts to reduce carbon emissions through tax measures (imposing the social cost on polluters) may simply lead to a fall in producer prices, with little change in consumption and therefore carbon emissions. In some models, the incidence of the tax would fall wholly on the resource owner's rent. For the same reason, the introduction of new renewable-energy technologies may simply accelerate the use of carbon-intensive energy sources[22] – as the owners of the natural resource try to sell them off before they become obsolete or fall sharply in value. In these circumstances – for some market structures, and in the absence of carbon capture and storage – optimal tax theory can suggest that a declining ad valorem[23] tax rate over time may eventually be desirable, to delay fossil-fuel consumption and push back in time the impacts of climate change[24]. In this case, the tax rate through time reflects more than the social cost of carbon, as it is also takes account of these other market dynamics. The key point here is that there are many complexities that should be considered.[25]

Under a tradable quota system, the price associated with an emissions quota may be much higher than expected if exhaustible-resource pricing is ignored. In effect, rent may be transferred from the owners of fossil fuels to the owners of the allowances (or issuers, if allowances are auctioned). More generally, if trading creates rents, it may undermine the acceptability of policy and lead to gaming, wasted resources in rent-seeking, and possibly corruption. Where incumbent firms enjoy rents, they may also discourage competition and new entry.

14.7 Public finance issues

Both taxes and tradable quotas can be used to raise public funds. Carbon taxes automatically raise public revenues, but tradable-quota systems only have the potential to raise public revenue if firms have to purchase the quotas from government through a sale or auction.

Carbon taxes automatically transfer funds from emitting industries to the public revenue. This transfer may be used to:

- enhance the revenue base[26];
- limit the overall tax burden on the industry affected through revenue recycling[27];

[19] See Blyth and Hamilton (2006) for background discussion on the nature of electricity markets, interaction with fossil fuel markets and issues to consider for policy approaches to introducing climate policy to electricity systems.
[20] This would shift rents from OPEC to Kyoto countries.
[21] Hepburn (2006)
[22] The economic theory of exhaustible natural resources is exposited in e.g. Hotelling (1931) and Dasgupta & Heal (1979).
[23] Ad valorem taxes are based on the value or price of a good or service. The alternative to ad-valorem taxation is a fixed-rate tax, where the tax base is the quantity of something, regardless of its price.
[24] There is a debate about whether the tax rate should first rise and then fall. See Ulph & Ulph (1994) and Sinclair (1994).
[25] For a more detailed discussion, see Newbery (2005).
[26] In practice, the overall impact on the revenue base may be limited, if taxes are reduced elsewhere in the economy.

- reduce taxes elsewhere in the economy;

Revenue recycling to the industry can encourage emitters to reduce GHG emissions, without increasing their overall tax burden relative to other parts of the economy[28]. The advantage of this approach is that it can ease the initial impact of the scheme for those industries facing the greatest increase in costs, and therefore ease the transition where carbon taxes are introduced. As the introduction of carbon pricing through taxation is a change to the rules of the game (which will affect shareholders in the short run), there is a case for some transitional arrangements. Over time, however, recycling may discourage or slow the necessary exit of firms from the polluting sectors. Monitoring and protecting the position of incumbents in this way could also reduce competition.

Alternatively, revenue from carbon taxes can be used to reduce taxes elsewhere in the economy. In such circumstances, the revenue from the carbon tax is sometimes argued to generate a so-called 'double dividend' by allowing other distortionary taxes to be reduced.

But this argument needs some care. There is no doubt that environmental taxes have the special virtue of reducing 'public bads', at the same time as they generate revenue. Reducing the 'bad' is indeed central to any assessment of this type of tax. But arguments invoking the so-called 'double dividend' as sometimes advanced in general terms (i.e. that there is always a double dividend), can be incorrect. Putting the reduced public bad to one side for a moment, there is a 'dead-weight' loss to the economy from raising any tax on the margin. Whether it is greater or less with goods associated with carbon (compared with other goods or services) is unclear and depends on the circumstances. For example, where energy is subsidised, reducing the subsidy (equivalent to raising the tax) will probably be a gain in terms of reducing deadweight losses. Note, however, that where other taxes have been optimally set - and abstracting from the externality – then the deadweight loss on the margin from increasing any one tax will be exactly the same as on another and there will clearly be no 'double dividend' in this context.

This is not an argument against raising revenue through pricing GHG emissions. On the contrary: there are strong benefits from ensuring that GHG emissions are properly priced to reflect the damage they cause. Thus GHG taxes have the clear additional benefit relative to other ways of raising revenue of reducing a 'bad'. Where that benefit has not been adequately recognised, they will be underused relative to other forms of taxation.

In contrast, a quota-based system will not automatically raise revenue unless firms must initially purchase some or all quotas from the government in either an auction or a direct sale. In constrast, if quotas are allocated for free, then the asset is passed to the private sector and the benefits ultimately accrue to the owners and shareholders of the firms involved[29]. In the short term, there may be reasons for introducing auctioning slowly – to ease the transition to a new policy environment. Equally, finance ministries will want to ensure that the overall tax revenue base is reliable and predictable: revenues from auctioning may be less predictable than those from taxation. In the long term, however, there is little economic justification for such transfers from the public sector to individual firms and their shareholders[30].

Free allocation of quotas to business also has a number of other potential drawbacks. These are discussed in more detail in the next chapter, which focuses on practical issues associated with the implementation of tax and trading schemes.

In summary, a tax-based approach will automatically generate public revenues, whereas a tradable-quota approach will only generate revenues if quotas are sold. Requiring firms to pay for the right to pollute is consistent with a move to raise revenue via the taxation of 'bads'

[27] The ultimate incidence of the tax is on the industries' customers and – in the absence of perfect competition – shareholders.
[28] Although, as already noted, in a competitive industry the tax will ultimately fall on the consumer.
[29] To the extent that firms are able to pass on to consumers the increase in marginal production costs, a system with free quotas may be regressive (because shareholders tend to be wealthier than the general population).
[30] Where the ultimate incidence of the tax falls on customers, they pay a price of carbon, but there is no benefit to the wider revenue base.

rather than 'goods'[31]. In the case of climate change, where understanding of the potential damage caused by emissions continues to improve, there is a strong argument for shifting the balance of taxation. In the case of tradable quotas, there are good economic reasons for moving towards greater use of auctioning over time, though the transition will need to be carefully managed – in particular, to ensure a robust revenue base.

14.8 Co-ordinating action across countries

The mitigation of climate change requires co-ordinated action across different countries. In thinking about the differences between tax and tradable quotas, it is therefore important to recognise the different implications they have for market-driven financial flows between countries.

Chapter 22 will explore the challenges in building up broadly similar price signals for carbon around the world. Issues of equity – as discussed in Chapter 2 – are likely to be central to creating frameworks that support this goal. It is therefore important to consider how taxes and tradable quota systems may differ in the relative ease with which they can drive financial flows between countries.

In theory, either a tax or a tradable quota system could drive financial flows from the developed to developing countries. Under a tax-based system, revenues raised will in the first instance flow to national governments. An additional mechanism would need to be put in place to transfer resources to developing countries.

Under a tradable-quota system, there are a number of ways that governments in rich countries can drive flows, either through direct purchase of quotas allocated to developing countries or through the creation of company-level trading where companies have access to credits for emissions reductions created in developing countries. In this case, financial flows between sectors and/or countries can occur automatically as carbon emitters search for the most cost-effective way of reducing emissions. The opportunities and challenges in these areas are discussed in detail in Chapters 22 and 23.

In summary, financial flows from developed to developing countries can occur under either a tax or tradable-quota system. However, market-driven financial flows will only occur automatically under the latter route, and only at sufficient scale if national quotas are set appropriately.

14.9 The performance of taxation and trading against principles of efficiency, equity and public finance considerations

In terms of the criteria discussed above – efficiency, equity and public finance – carbon taxes perform well against the efficiency and public finance criteria, as they:

- can contribute to establishing a consistent price signal across regions and sectors. However, this may prove difficult if a country perceives that it is acting in isolation, and – as discussed in chapter 22 – there are many reasons why achieving a common price signal through harmonising taxes across countries is likely to be difficult to achieve;
- raise public revenues;
- can be kept stable, and thus do not risk fluctuations in the marginal costs that could increase the total costs of mitigation policy.

[31] Were auctioning to substitute in whole or in part for taxation, it would be important to manage the revenue base to underpin the sustainability of the public finances.

However,

- they do not automatically generate financial flows to developing countries in search of the most effective carbon reductions.

In terms of the criteria discussed above – efficiency, equity and the impact on public finances – the strengths of a tradable quota scheme are:

- to the extent that the scheme embraces different sectors and countries, it will establish a common price signal and therefore have the potential to drive carbon reductions efficiently;

- to the extent that inter-country trading is allowed, it will ensure carbon reductions are made in the most cost-effective location, and automatically drive private-sector financial flows between regions;

- if allowances are sold or auctioned, then the scheme also has the potential to generate public revenues.

Some countries may make substantial use of tax measures to reduce GHG emissions. Others may place greater emphasis on participation in emissions trading schemes or, indeed, regulation. Some countries may choose a mix of all three depending on the sector, other policies, market structures, and political and constitutional opportunities and constraints.

The effectiveness of any tax or emissions trading scheme depends on its credibility and on good design. Investors need a credible and predictable policy framework on which to base their investment decisions; and good design is important to ensure effectiveness and efficiency. This is discussed in detail in the next chapter.

Carbon-pricing policy is only one element of a policy response to climate change. There are a range of other market failures and barriers to action which must be tackled. For this reason, carbon pricing policy should sit alongside technology policies, and policies to remove the behavioural barriers to action. These two further objectives are discussed in Chapter 16 and Chapter 17 respectively.

14.10 Conclusion – building policies for the future

A shared understanding of the long-term goals for stabilisation is a crucial guide to climate change policy-making: it narrows down strongly the range of acceptable emissions paths, and establishes a long-term goal for policy. But, from year to year, flexibility in when, where and how reductions are made will reduce the costs of meeting these goals. Policies should adapt to changing circumstances as the costs and benefits of climate change become clearer over time. This means that short-term policy may be revised periodically to take account of information, as and when it comes, so as to keep on track towards meeting a long-term goal.

This need for both a long-term goal, and consistent short-term policy to meet this, should guide action at the international and national level to price carbon.

At the international level, this means that the key policy objectives for tackling climate change should include:

- Choosing a policy regime that:

  i. in the long term, will stabilise the concentration of greenhouse gases in the atmosphere, and establish a long-term quantity goal to limit the risk of catastrophic damage;
  ii. in the short term, uses a price signal (tax or trading) to drive emission reductions, thus avoiding unexpectedly high abatement costs by setting short-term quantity constraints that are too rigid.

- Establishing a consistent price signal across countries and sectors to reduce GHG emissions. This price signal should reflect the damage caused by carbon emissions.

In theory, either taxes or tradable quotas – and in specific circumstances regulation – can play a role in establishing a common price signal. Chapter 22 discusses the potential difficulties of co-ordinating national policies to achieve this.

Both taxes and tradable quotas can contribute to raising public revenues. Under a tradable quota scheme, this depends on using a degree of auctioning and, over time, there are sound economic reasons for doing so. However, this would need to be well managed, understanding fully the implications for governments' revenue flows, and ensuring that these remain predictable and reliable.

Taxes and tradable quotas can both support the financing of carbon reductions across different countries. However, only a tradable-quota system will do this automatically, provided there is an appropriate initial distribution of quotas and structure of rules.

At the national – or regional level – governments will want to tailor a package of measures that suits their specific circumstances, including the existing tax and governance system, participation in regional initiatives to reduce emissions (eg. via trading schemes), and the structure of the economy and characteristics of specific sectors.

Some may choose to focus on regional trading initiatives, others on taxation and others may make greater use of regulation. The factors influencing this choice are discussed in the following chapter.

References

Useful background reading that summarises the debate on the use of price or quantity instruments are included in the list below. The seminal article by Weitzman (1974) is a technical exposition of the arguments. Pizer (2002) is good outline of the debate in terms of international climate change policy. Hepburn (2006) outlines a clear application of the Weitzman analysis to climate change policy, including the trade-off between credible commitments and flexibility.

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