Chapter 27

Economic Instruments for Climate Change

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Climate policy instruments have proliferated around the world – there are now several thousand climate policy interventions – but the major policy debate remains focused on the choice between different types of "economic instruments" to put a price on carbon dioxide emissions. Economic instruments include carbon taxes, which directly create an explicit price on emissions of carbon dioxide, and emissions trading schemes, which indirectly create an explicit price, through the creation of a market in licenses or permits to pollute. Economic instruments might be contrasted with so-called "command-and-control" regulatory measures, which do not create an explicit price on pollution (Hepburn 2006).[1]

The pervasiveness of greenhouse gas (GHG) emissions in modern economies and the substantial associated mitigation cost has led policy-makers to focus on cost-effective economic instruments for climate change. A broad price incentive is viewed as a necessary (but likely not sufficient) policy intervention. Since the late 1980s, climate policy debates have therefore focused in on the relative merits of taxes and trading schemes. Thirty years later, both instruments are in use, and new carbon taxes and emissions trading schemes continue to be created in different countries around the world. However, emissions trading appears to have emerged as the dominant economic instrument in climate policy mixes around the globe (Meckling 2011b), and reflects a broader trend toward market-based environmental policy (Newell 2008).

The EU Emission Trading Scheme (EU ETS) is currently the largest cap-and-trade scheme in the world. In addition, the Clean Development Mechanism (CDM) under the Kyoto Protocol allows developing countries to participate in emission-reducing, credit-generating activities. A number of other industrialized and emerging economies are designing or implementing cap-and-trade schemes, notably Australia and South Korea. In 2010, the carbon markets were worth US$142 billion (Point

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Carbon 2011), although trading values have crashed, along with market prices, in 2011 and 2012 due to, among other things, weak economic activity in the Eurozone.

This chapter discusses the economics, politics, and governance of economic instruments for climate change mitigation. We first review the economic arguments for carbon taxes and emissions trading. In particular, we compare the two instruments along a number of criteria, including economic efficiency, effectiveness, flexibility and credibility, administrative cost, industrial dynamics, and international aspects. Thereafter, the chapter offers an overview of the politics of carbon tax and emissions trading proposals in the international negotiations, the EU, and the USA. We will discuss the political economy of climate policy instruments, explaining why emissions trading could mobilize a larger political constituency than carbon taxes. Next we outline the current landscape of carbon markets, including their geographic scale, financial scope, their performance and governance. Finally we offer our conclusions.

The Economics of Pricing Carbon: Emissions Trading vs. Pollution Taxes

Standard economic theory holds that the problem with pollution is that polluters do not incur the costs of their actions, so they pollute excessively. Economics suggests several solutions. Government can intervene by "command and control" – firms can be required to reduce pollution by a certain amount. However, it is very difficult for governments to determine how much each individual firm should optimally contribute to the total reduction in pollution, as this requires detailed information on individual firms' costs. This leads to potentially vast inefficiencies, particularly for a problem such as climate change where abatement costs vary widely.

There are two simple solutions that can achieve the optimum allocation of pollution reduction between firms, without requiring unmanageable amounts of information and government planning. Pigou (1920) proposed direct taxation of pollution, creating a fixed and explicit price on pollution. Alternatively, Coase (1960) noted that capping the total quantity of pollution and allowing firms to trade in a market would yield an (indirect) market price on pollution, and an efficient allocation of abatement between firms.[2] Hybrids between the two are possible, and even in their pure form these two simple economic instruments can be implemented in a wide variety of different ways.

Pollution taxes can be levied "upstream," near to the point of extraction of the polluting resource (e.g. fossil fuels), "downstream" (e.g. at the point of emission by consumers using gasoline in vehicles), or somewhere in between. Taxes are often imposed as a flat rate per unit of pollution (e.g. $\$/tCO_2$), but an increasing (or decreasing) schedule of tax rates could also be imposed, not unlike income tax schedules. Finally, as with any tax regime, exemptions may be granted to certain sectors or groups, often with the aim of protecting internationally exposed industries, or helping poorer or more vulnerable consumers.

Cap-and-trade systems can also be implemented in a variety of ways. Regulated entities can be upstream, downstream, or in between. In most carbon-trading schemes, such as the EU ETS, the regulated entities are direct sources of emissions. For trade-exposed industries, government might hand out some permits for free. Indeed, in most environmental trading schemes, a very high proportion of allowances are given for free to polluters.

Trading schemes can provide further flexibility in how regulated companies meet their obligations (Fankhauser and Hepburn 2010a, 2010b). Offsets from projects that reduce emissions outside the regulated sectors (or in other countries) can be permitted as a way of further reducing the cost of achieving a given environmental goal (Hepburn 2007). Regulators may allow firms to "bank" permits from one period to the next, so that they can choose to make more emission reductions early and sell or use their permits later if they believe prices will rise (Fankhauser and Hepburn 2010a). One of the concerns about trading schemes is that while they fix a specific quantity of emissions, the pollution price is uncertain and potentially sometimes quite volatile. To address these concerns, price ceilings and floors can be imposed on the market, to create a so-called "hybrid" system, which blend features of tax and trading schemes.

So, are pollution taxes "better" in theory than trading schemes? Do hybrids offer the best of both worlds? Unsurprisingly, the answer depends upon the particular pollutant and the specific domestic and international political context. The relevant criteria by which policy-makers might choose the suitable instrument include: (i) efficiency (under uncertainty and policy lags); (ii) environmental effectiveness; (iii) credibility and flexibility; (iv) market dynamics; (v) administrative costs; (vi) international considerations; (vii) political issues; and (viii) governance challenges. Political issues are considered in the section on "Emissions Trading vs. Pollution Taxes"; governance challenges in the section on "The State and Performance of Carbon Markets." Here we examine the first five considerations.

Efficiency

There is a basic symmetry between taxes and trading. Taxes directly set an explicit price, while a trading scheme indirectly creates an explicit price, revealed by the market. Under idealized conditions, if the regulators are aiming at the same objectives, the market price under the trading scheme will equal the level of the optimum tax (Weitzman 1974). A looser cap translates into setting a lower tax, and vice versa. Under idealized conditions, there is a one-to-one correspondence between taxes and trading, and their implications for economic efficiency are identical.

However, the real world is far from ideal, and there are various reasons one might expect taxes and trading schemes to have different implications for economic efficiency. For instance, climate change is an inherently international problem; to minimise costs, carbon prices would be the same in all countries. Yet if each nation imposed carbon taxes, in their own currencies, those tax rates would need to be continuously adjusted to reflect changing foreign exchange rates. In contrast, usual processes of market arbitrage would ensure that a global emissions market implied an equivalent permit price in all relevant currencies from day to day and even hour to hour.

Another reason is that policy-makers do not know what the "optimum" pollution price or cap is going to be in advance – this depends upon how much it costs companies to clean up the pollutant, and how damaging it is. Both can be estimated, but are not known with certainty. When abatement costs are uncertain, Weitzman (1974) showed that the basic symmetry between taxes and trading is lost. Neither instrument can be certain to be optimal. The aim is to minimize the *expected* efficiency

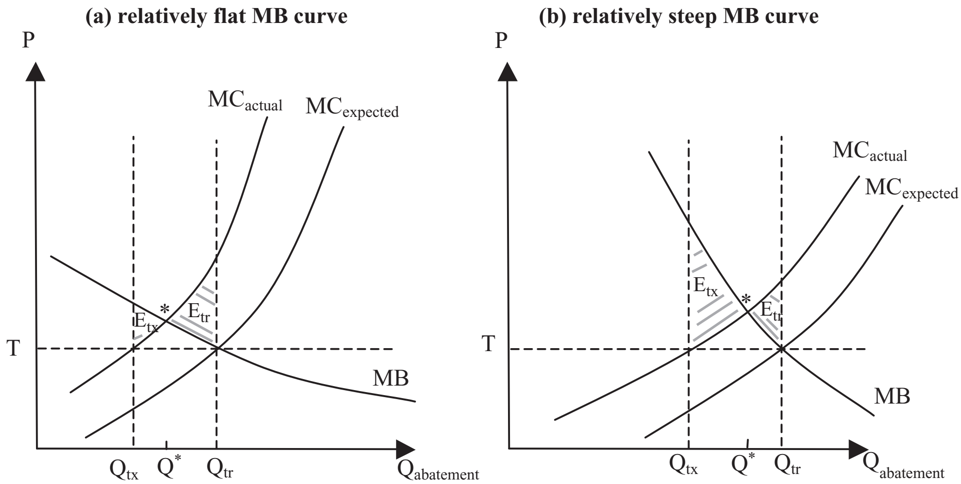

Figure 27.1 Trading has lower expected efficiency loss with a steep marginal benefit curve. Source: Adapted from Hepburn, Cameron. 2006. "Regulation by Prices, Quantities, or Both: A Review of Instrument Choice." *Oxford Review of Economic Policy*, 22(2): 226–247.

loss. Weitzman (1974) demonstrated that under certain conditions, the efficiency loss depends upon the relative slopes of the marginal costs (MC) and the marginal benefits (MB) of abating pollution. Trading is more efficient when the marginal benefit of pollution reduction increases rapidly as more pollution is emitted (or the less pollution is abated), relative to the marginal costs of abating the pollution. On the other hand, taxes are likely to be more efficient when the MB is reasonably constant, that is, when one unit of pollution does around as much damage as any other unit of pollution.

Figure 27.1 provides an illustration where the actual marginal costs of abatement are higher than originally expected. Here, the tax (T) generates too little abatement ($Q_{tx} < Q^*$) leading to efficiency loss shown by the shaded area E_{tx}. In contrast, the trading scheme with cap Q_{tr} leads to too much abatement ($Q_{tr} > Q^*$) and efficiency loss E_{tr}. As Figure 27.1 shows, the tax has a lower efficiency loss compared to trading ($E_{tx} < E_{tr}$) when the MB curve is relatively flat, and vice versa.

This analysis is limited in various ways: it doesn't consider uncertainty in the marginal benefit curve, nor does it consider the possibility that policy-makers will realize their error and adjust policy to correct for it, nor does it consider transitional efficiency losses. Critically, it also assumes that there are no known "tipping points" in the climate system. However, a broad conclusion that can be drawn from this analysis is that for a stock pollution problem like climate change, if policy is adjusted over short periods, and in the absence of known "tipping points," then taxes are the more efficient policy instrument under uncertainty.

Environmental Effectiveness

A simple but important consideration is whether the policy instrument will actually achieve the intended objective of reducing emissions. One of the major disadvantages of price instruments such as carbon taxes is that they cannot provide this guarantee, unlike cap-and-trade systems. Returning again to Figure 27.1, if the international community agrees that Q_{tr} is the appropriate level of abatement, an emissions trading scheme will achieve that, irrespective of whether costs and benefits shift. Indeed, one of the reasons the price in the EU ETS is currently so low is because economic activity in Europe has collapsed, as have emissions, and hence the cost of abatement is considerably lower than previously. As the target has not moved, the permit price has fallen. If economic activity picks up, the price rises in order to ensure the target is achieved. With a fixed tax, in contrast, changes in abatement costs (e.g. due to a recession or a boom) would lead to abatement which is above or below the target.

Credibility and Flexibility

One of the major challenges of climate policy is the long-term nature of the response. Policy incentives that are allegedly supposed to last for several decades need to be credible before the private sector will make investments in reliance upon them. This credibility problem is acute in nations when climate policy is highly politicized – each new administration finds it expedient to roll back the policies of the previous one.

Helm *et al.* (2003) define the credibility problem as being caused by conflicts between multiple objectives (e.g. energy costs, emissions, energy security), the irreversible nature of the necessary capital investments, and the scope and incentive for ex post reneging on earlier policies. Of course, there is also merit in policy flexibility to respond to new events. This does not necessarily imply discretion, however. Policy can be designed with clarity over the rules that would guide adjustments in the light of new information. If it is suspected that politics creates risks that such rules will not be followed, delegation to an independent agency, as with the delegation of monetary policy to central banks, can provide a solution (Helm *et al.* 2003).

These considerations have a bearing on the design and implementation of the relevant economic instrument. In the UK for instance, power was delegated to the CCC to advise on emissions budgets rather than on tax rates, partly because HM Treasury guards taxation powers closely. An independent agency with power to set (or advise on) taxes may have been less credible. In the EU ETS, changes to the cap, for instance, require negotiation and agreement by the relevant EU member-states. This implies that the cap is difficult to adjust, for better or worse. This enhances credibility but reduces flexibility. It is unclear whether adjustments to an EU-wide tax would be more or less straightforward. It can be argued that trading schemes such as the EU ETS might further increase their credibility by incorporating some kind of mechanism to stabilize prices, whether in a hybrid model with floors and ceilings, auction reserve prices (Hepburn *et al.* 2006), or gateways (Fankhauser and Hepburn 2010a).

Industrial Dynamics

In a broader sense, different price instruments generate different industrial dynamics, a feature not often commented upon by economists. For instance, carbon taxes provide a stable price signal that favors investment by risk-averse firms. They create incentives for greater activity by accountants. For better or worse, taxes tend to promote business-as-usual to a greater extent than trading. Taxes also promote greater market concentration in oligopolistic industries (Hepburn *et al.* forthcoming), although this effect should also be observed from the price incentives arising from trading schemes. The overarching discourse in an environmental tax regime is one of "tax minimization" and the industrial focus is on the stick rather than the carrot.

In contrast, carbon trading can lead to a more volatile, higher-risk environment, with greater potential for creative destruction, with both its good and bad aspects. Prices can move wildly, and the financial derivatives created to manage price risk also allow market participants to speculate on price movements to make leveraged gains or losses. However, a new market also creates the possibility of new business models, where entrepreneurs can grow clean energy firms that, through their activities, acquire tradable property rights.

Similarly, with a trading scheme, the discourse within financial and industrial firms is not merely about "compliance," but also focuses on "profit opportunities," either from trading or by identifying previously unknown abatement opportunities and making a profit margin when these are cheaper than market prices. Finally, the large emitters who are granted emissions permits for free find themselves with a new (and often substantial) asset on their balance sheet, which they can use to secure finance for new initiatives, clean or otherwise.

Administrative Costs

Administrative costs – which are largely a deadweight loss – can vary widely from one policy choice to another (Krutilla and Krause 2011). The application of a policy "downstream," placing compliance obligations on individuals, can create an enormous burden (Kahn and Franceschi 2006). For instance, if every individual (including the young and the elderly) had a tradable "personal carbon allowance," the IT costs would be enormous, not to mention the transaction costs and delays of ensuring that an adequate number of allowances were retired with each fuel purchase. One suspects that grandparents have better things to do than to trade their personal carbon allowances on a market. Equally, the privacy implications of a personal carbon-trading scheme may be significant.

At the other end of the spectrum, selecting the largest emitters and controlling pollution "upstream" can reduce transactions costs (Smith 2007). For instance, the Australian emissions trading scheme passed in November 2011 applies to roughly the largest 500 emitters in the country. The EU ETS applies to just over 10 000 installations, rather than the several hundred million European citizens. These policy choices considerably reduce transaction costs.

As between trading and taxes, there is little doubt that the administrative costs of taxes are lower than of setting up a trading scheme (Kahn and Franceschi 2006). Existing government taxation infrastructure can be deployed which, while non-trivial, is nowhere near as complex as the infrastructure required for the establishment of a fully functioning and well-regulated market, with the various elements of the industrial ecosystem that this entails. Once the market infrastructure has been set up, however, trading costs can be relatively low, and bid-ask spreads relatively low, allowing the system to reasonably efficiently work so that that those who value the permits most end up holding them. Additional features of trading, such as offset mechanisms, can also involve high administrative costs – although they reduce the overall costs of abatement. For instance, the administrative burden of the CDM implies that projects must reduce emissions by around 30 000–40 000 t. of carbon dioxide a year at a minimum before it is worth bothering with the costly and lengthy validation, registration, and verification processes.

International Considerations

Finally, the choice of policy instrument also depends upon international considerations. Does the instrument dovetail with obligations under international agreements? Is it consistent with the policy choices of trading partners? In the climate context, the fact that international negotiations tend to be conducted in quantities (e.g. 2020 emission reduction targets) rather than prices (e.g. carbon tax rates) can make it easier to transpose these obligations domestically by implementing a cap-and-trade regime. As noted above, it is far easier to use international markets to harmonize carbon prices and account for fluctuating exchange rates than it is to rely upon periodic intergovernmental meetings to adjust carbon taxes. It is entirely possible to achieve an international quantity target using a series of (potentially different) price instruments domestically, but it provides less certainty, and it also does not achieve global efficiency if prices differ between countries.

If trading partners also elect to regulate climate change by emissions trading, then linking markets together can further reduce costs by exploiting spatial variation in abatement costs (Fankhauser and Hepburn 2010b), and provide the benefits of deeper and more liquid markets (which also reduce transaction costs).

Overall

An economic analysis of instrument choice for climate change can be summarized as follows. First, for such a vast and challenging policy problem, cost-effectiveness is critical so economic instruments should be deployed. Second, for a problem like climate change with a relatively flat marginal damage function (unless and until a tipping point is located at a specific concentration), carbon taxes are more efficient under uncertainty. Third, carbon taxes likely involve lower administrative costs than the creation of a market. Fourth, taxes are likely to provide a more stable signal for investors. However, fifth, only emissions trading guarantees a particular environmental outcome. Sixth, trading appears to fit better with the international nature of the problem. Seventh, trading creates clearer opportunities for entrepreneurs to find new ways to reduce emissions and reduce costs of mitigation. Eighth, trading leverages the profit motive of firms who are more likely to support it.

The net result of this analysis is that the choice between trading and taxes is an important but second-order consideration to the need to get a carbon price in place through whatever mechanism is most politically feasible. As we will argue in the next section, the evidence so far suggests that trading has more appealing political features (cf. Meckling 2011b). Further, as Fankhauser and Hepburn (2010a, 2010b) argue, slight tweaks to make an ETS more "tax-like" – including long commitment periods, banking, and some kind of "price management" – can help an ETS to gain some of the advantages of taxes without the concomitant disadvantages.

The Politics of Pricing Carbon: Emissions Trading vs. Pollution Taxes

The previous section examined the economic theory of instrument choice. This section considers the politics. We provide a political history of the debates on taxes and trading and explore the political economy reasons for the current dominance of trading over taxes. In Europe, carbon trading has clearly been the most significant policy intervention on climate change, with greater impact than command-and-control regulation, voluntary initiatives, and carbon taxes. But in a historical context, the rapid initial adoption and the current, if somewhat unsteady, trend towards globalization of GHG emissions trading is puzzling given the strong initial opposition from EU governments, the majority of environmental groups, and parts of industry. Different explanatory accounts of the rise of carbon trading have focused on the role of transnational coalitions of firms, state actors, and green groups (Meckling 2011a, 2011b), point to the role of liberal norms (Bernstein 2001), the role of states or supranational institutions – especially the European Commission (Skjærseth and Wettestad 2008), the role of global capital (Matthews and Paterson 2005; Newell and Paterson 2010), and the role of financial service centers, such as New York and London (Knox-Hayes 2009), as driving forces. These narratives are not always mutually exclusive or mutually consistent, yet a comprehensive discussion is beyond the scope of this chapter. We focus here on laying out key historical steps in the political battle over pricing carbon, before we discuss the political economy of different market-based climate policy instruments.

The Politics of Carbon Tax Proposals in the EU and the USA, 1991–1993

In the early 1990s, environmental groups in both the EU and the USA were largely in favor of a carbon tax to address global climate change. After the UN Framework Convention on Climate Change was signed in 1992, the domestic battle over climate policy unfolded. After President Clinton took office in January 1993, he announced the US target of reducing GHG emissions to 1990 levels by 2000. In support of this stabilization target, the administration proposed a tax to be based on the heat content of the fuel. The tax was rejected by the Senate, which at that time had a Democratic majority. The US oil industry played an important role in killing the tax proposal (Newell 2000: 100). As a consequence of its defeat in the case of the carbon tax, the Clinton administration became increasingly inaccessible to the oil industry but instead consulted more closely with the environmental movement (Skjærseth and Skodvin 2003). The political cleavage increasingly ran between business, on the one hand, and environmental groups and the administration, on the other.

A similar battle was fought in the EU (Meckling 2011b). Preparing for the Rio conference, the European Commission proposed a package on climate policy including a carbon/energy tax in 1991. This was fiercely opposed by European industry associations spearheaded by Business Europe (formerly UNICE), the umbrella organization of 34 business associations, and by EUROPIA (Skjærseth and Skodvin 2003). The latter rejected any new tax on fossil-fuel products. The lobbying campaign proved successful, as the implementation of the tax was made conditional upon other OECD countries following suit, which was not going to happen. Furthermore, the UK rejected it decisively in 1993, and other member-states did not come out with strong support for the proposal, either. This meant the *de facto* burial of an EU-wide carbon tax. While some national carbon taxes have been implemented since the 1990s, notably in Denmark, the story has been a complicated patchwork of efforts more notable for their failures than their successes. The experience with the defeat of carbon/energy tax proposals had a lasting effect on policy-makers on both sides of the Atlantic. They acknowledged that some form of business support for the choice of instrument was crucial in order to be able to pass mandatory climate policy.

The Emergence of Emissions Trading on the International Agenda, 1994–1999

While international greenhouse gas emissions trading had been discussed among a small group of scholars and policy-makers since 1989, it emerged as a viable policy option only in the international negotiations in the mid-1990s. The First Conference of the Parties (COP) of the UNFCCC in Berlin in 1995 put international emission reduction targets and timetables firmly on the agenda. The so-called Berlin Mandate represented a watershed in the negotiations and was a major success for the environmental movement (Alcock 2008). At COP 2 of the UNFCCC in Geneva the next year, the US delegation proposed the use of "trading mechanisms" in implementing the emission reduction target. Emissions trading had been officially placed on the agenda of international climate politics. The US proposal arose from a number of mostly domestic processes. First, the US administration preferred emissions trading as a market-based policy since the successful and highly cost-effective implementation of the domestic sulfur dioxide trading scheme. Second, a new informal transnational alliance of firms and green groups had emerged that promoted market mechanisms (Meckling 2011b). European oil major BP and the green group Environmental Defense spearheaded a new political strategy among business and environmental groups that focused on the promotion of market-based climate policy. Market mechanisms appeared as the compromise solution between industry's reluctance to accept any kind of mandatory emissions targets and the environmental community's preference for command-and-control policies. The new advocacy strategy of some firms and environmental groups and the Clinton administration's foreign climate policy co-evolved, giving momentum to market-based mechanisms.

Initially, the proposal met with strong resistance from the EU and developing countries (Bodansky 2001). European governments lacked experience with the instrument and their environmental constituency perceived emissions trading to be granting a "license to pollute." Developing countries were mostly concerned that emissions trading would allow industrialized countries to escape domestic emission reductions. Yet during the 1997 Kyoto conference, the USA and its allies among business and environmental groups actively promoted the idea of market mechanisms in particular among European governments. In the end, flexibility mechanisms were included in the protocol as part of a compromise deal between the EU and the USA: while the EU accepted emissions trading, the USA agreed to an internationally binding emission reduction target. Developing countries were – with the exception of Brazil's support for the CDM – not in favor of emissions trading. This is noteworthy, as it would later change, when the CDM market channeled funds to emerging economies in particular. Once emissions trading was a constitutive part of the international climate policy framework, the political focus shifted to the ratification and implementation of the protocol at the national level, especially within the key entities such as the EU and the USA. The EU surprisingly took the lead.

The Creation of the EU Emission Trading Scheme, 2000–2005

Despite its initial opposition to tradable permits, the EU designed and implemented the first cross-border emissions trading scheme. The political momentum to go ahead with emissions trading in Europe grew from the bottom up, starting in the UK. Under the influence of BP, UK oil and power companies saw an opportunity to put emissions trading firmly on the European agenda if the UK pioneered a trading scheme. They therefore set up the UK Emissions Trading Group (UK ETG) with the support of the UK government (Nye and Owens 2008). An advocacy coalition at heart, the UK ETG developed the UK ETS, which became operational in 2002. The UK ETG and corporate leaders on emissions trading in general were arguably driven by an anti-taxation agenda, and as such, were mainly pursuing a pro-regulatory risk-management strategy.

The pioneering work in the United Kingdom subsequently spurred action at the EU level, *inter alia*, to prevent regulatory fragmentation within the EU. The European Commission became a powerful driver of an EU-wide scheme in its own right. The Commission had a number of reasons for supporting emissions trading in Europe (Zapfel 2005; Skjærseth and Wettestad 2008). First, the European Commission felt that a carbon tax was doomed to fail, as it had in the early 1990s because of business opposition. Business, in turn, was aware of the political will to implement mandatory climate regulation in the EU. Second, the development of the UK and Danish trading schemes spurred fears of regulatory fragmentation in the EU, which could have undermined integration achievements with regard to the internal market and environmental policy. Third, officials were critically aware of the fact that the acceptance of emissions trading was the price the EU had to pay to get the USA to ratify the Kyoto Protocol.

The advocates of carbon trading in Europe did not remain unchallenged. German industry and energy-intensive manufacturing industries were particularly opposed to a European trading scheme (Christiansen and Wettestad 2003). Unlike in the USA, environmental groups were not among the carbon-trading champions but were instead on the fence. They became watchdogs for the environmental effectiveness of the scheme only at a relatively late stage in the process. After the EU ETS had entered its implementation phase in early 2005, the coalition supporting it became increasingly at risk of fragmenting, as business was divided over the stringency of the system. The financial services industry started to advocate a more stringent EU ETS, which the big emitters from the energy industry and energy-intensive manufacturing industries tried to avoid.

The Proliferation of Trading Schemes: The USA and Asia-Pacific, 2006–2011

After Kyoto, the USA implemented voluntary climate policies for a number of years. During the Clinton administration, the Senate was the major hurdle for any mandatory climate policy. After the Bush administration withdrew the USA from the Kyoto Protocol in 2001, the executive and legislative branches were aligned regarding voluntary climate policy.

Yet business and state activities on the ground began to put emissions trading back on the US agenda. In 2003, the Chicago Climate Exchange, a private initiative, established the first GHG emissions trading scheme in the USA. In the same year, a number of northeastern US states set out to develop a regional emissions trading system for the power sector – what would become the RGGI, which started trading in 2009. Neither of these initiatives could be described as great successes, but they got emissions trading under way in what can be seen as an experimental period. In 2006, California passed the Global Warming Solutions Act, which kicked off a process to develop an economy-wide, state-level emissions trading scheme to be implemented by 2013. With business and US states moving forward with mandatory and market-based climate policy, pressure to enact mandatory emissions cuts at the national level increased.

The Democrats' win in the 2006 midterm elections increased the momentum for climate legislation in both the House and Senate, leading to a phase of heightened legislative activity on climate policy that further accelerated when President Obama entered office in 2009. Legislative activity in the US Congress culminated in the passage of the Waxman–Markey Bill – a comprehensive cap-and-trade bill – by the House of Representatives in 2010. It was supported by a large alliance of environmentalists and firms who had organized in the US Climate Action Partnership. Yet the bill never came to a vote in the Senate. Health-care reform ranked higher on the political agenda, the economic crisis led to concerns about the costs of climate legislation, and the financial crisis, low permit prices, and fraud in the EU ETS led to questions regarding the value of carbon trading in general. The window for federal climate legislation closed as political parties entered campaign mode ahead of the presidential elections in 2012.

Meanwhile, a similar trend towards adopting domestic emissions trading schemes can be observed in the Asia-Pacific region, notably in New Zealand, Australia, and Japan. In September 2008, New Zealand passed legislation on the New Zealand Emission Trading Scheme. New Zealand was the first country outside Europe to have a mandatory, economy-wide emissions trading scheme. In Australia, a prolonged political battle over climate policy arguably took the political scalps of two prime ministers and two leaders of the opposition, but eventually resulted in the passage of comprehensive climate legislation in November 2011 (Siegel 2011). In July 2012, the Australian government introduced a carbon tax as a first step. It is intended to transition to a cap-and-trade scheme in 2015.[3] In October 2008, Japan's government launched a voluntary trial carbon-trading scheme which is supposed to pilot a mandatory cap-and-trade scheme (Maeda 2008). In March 2010, the Japanese government proposed the Basic Act on Global Warming Countermeasures, which foresees a mandatory cap-and-trade scheme, a carbon tax, and a feed-in tariff for renewable energy sources (World Bank 2010). Other countries working on emissions trading schemes include China, Mexico, and South Korea (World Bank 2011).

The Political Economy of Instrument Choice

The central political-economic question regarding market-based climate policy is why carbon trading trumped carbon taxes, despite considerable opposition to the instrument from a range of actors. The brief answer is that the history of domestic and international climate politics shows that relatively broad coalitions can be mobilized for cap-and-trade proposals, but not for carbon taxes. The political economy of the choice of environmental policy instrument is driven by the distributional and environmental effectiveness of competing instruments. The distributional effects relate to wealth transfers between the private and public sectors, between different industry sectors and firms, and between different national economies. The environmental effects depend on different design characteristics of the policy instruments. In the following, we discuss how the distributional and environmental effects of emissions trading and carbon taxes respectively shape the policy preferences of major stakeholders, including governments, business, and environmental groups.

Governments have long been divided over how to price carbon. Throughout the first period of climate politics, the EU and developing countries opposed emissions trading, whereas the USA favored it in principle. The EU's initial preference for command-and-control policies, or a carbon tax, might be seen to be due to the preferences of the strong environmental movement in Europe, but also due to regulatory preferences in the coordinated market economies of continental Europe (Meckling 2011b). The USA's early preference for emissions trading reflected the successful introduction of the sulfur dioxide trading program in the domestic power sector. The cost-effectiveness of emissions trading has been a key driver of its appeal to the US government. Both carbon taxes and the auctioning of permits in a cap-and-trade scheme can create significant wealth transfers to government, which is unsurprisingly resisted by industry. However, industry worked on the (likely correct) assumption that taxes would generate greater revenues from them than permit trading schemes, which have usually been combined with the free allocation of permits (Hepburn 2006).

The reasons for business supporting emissions trading vary mostly by industry sector. Energy companies and energy-intensive manufacturing firms have viewed emissions trading as imposing lower burdens on them, compared with carbon taxes. While most emission-intensive firms have spent a lot of political energy in fighting caps in general, some firms – once faced with the inevitability of emission caps – supported emissions trading (Levy and Egan 2003; Meckling 2008). The early campaign for emissions trading by leaders such as BP was arguably an anti-taxation campaign, through which firms in emission-intensive industries tried to hedge their regulatory risk. The perception of the cost-effectiveness of carbon trading built mostly on the success of the sulfur dioxide trading scheme in the USA, which reached its environmental goals at 30% of the projected cost (US National Science and Technology Council 2005). Next to cost-effectiveness, the option of grandfathering emission permits, that is, handing out permits for free, has been attractive to business. Grandfathering can serve to contain compliance costs and to entrench incumbent advantage (US National Science and Technology Council 2005; Hepburn *et al.* forthcoming). Industry supported grandfathering in particular in cases of unilateral carbon regulation, as in the EU. It was seen to be able to mitigate potential negative competitiveness effects that would occur through carbon leakage, that is, the shift of production to unregulated territories. Yet theoretically a carbon tax that recycles revenues could achieve the same. Emissions trading has not only been more attractive than a tax to regulated entities, but also to the financial services sector due to its market-creating effect. Market service providers such as investment banks and law firms started seeing a business opportunity in carbon markets later on in the political process, as the first trading schemes went operational. Initially they were represented alongside the emitters in the International Emissions Trading Association (IETA). They later created their own trade association, the Climate Markets & Investment Association.

Environmental groups were – with the exception of the Environmental Defense Fund – not early advocates of emissions trading. They favored a carbon tax in the early phase of climate politics, as the politics of the carbon/energy tax proposals in the EU and the USA reflect. Yet in the mid-1990s a split emerged in the global climate change movement, when some green groups threw their political weight behind emissions trading (Alcock 2008). Reasons included the need to find a policy solution that could mobilize some business support and the notion of quantity certainty. Environmental groups came to like carbon trading because it set fixed emission reduction goals, which ensured the environmental integrity of the instrument. Henceforth, green groups in Europe and the USA played the role of advocates for a stringent form of cap and trade.

In sum, while pricing carbon is generally a hard political sell often facing significant opposition, emissions trading garnered more support than taxes. This is largely because the distributional and environmental effects of emissions trading are more attractive to parts of the environmental community, key state actors in Europe and the USA, and to big emitters and financial intermediaries. The cost-effectiveness, the market-creating effect, and the quantity certainty offered by emissions trading have been the predominant factors aligning interests around the instrument.

The State and Performance of Carbon Markets

What followed in the decade after Kyoto was not a top-down implementation of a global trading scheme but rather a bottom-up process of trading experiments and schemes. Academics and market actors have described it as fragmented (Tangen and Hasselknippe 2005), plurilateral (Sandor 2001), decentralized, and bottom-up (Victor *et al.* 2005). In the following, we outline the key market segments, discuss the performance of existing markets, and debate questions of the governance of carbon markets. We argue that while the carbon markets are highly fragmented and actors are still going through a learning curve, the EU ETS and the CDM have demonstrated some level of effectiveness. Yet the economic efficiency and environmental integrity of carbon markets critically hinges on the ability of actors to govern them.

The Scale and Scope of the Global Carbon Market

The global carbon market can be segmented in different ways – for one, in terms of the distinction between mandatory markets, mostly resulting from Kyoto commitments, and voluntary markets. In 2010, the mandatory markets dominated the carbon market with a share of more than 99% (World Bank 2011). The backbone of the compliance market, the EU ETS, accounted for 85% of the carbon market based on the value of EU ETS Allowances or for 97% including the secondary CDM market. Carbon markets globally were valued at US$142 billion (in terms of overall total value of transactions) in 2010 (World Bank 2011).[4]

The EU ETS is the only existing multilateral trading scheme for CO_2 and the world's largest mandatory cap-and-trade scheme. As a tributary market to the Kyoto Protocol, the scheme serves to achieve the EU's Kyoto target. Legislation for the EU ETS was adopted in 2003, and actual trading began in January 2005, with a pilot phase running until 2007. The second trading period of the EU ETS ran in parallel to the first commitment period under the Kyoto Protocol from 2008 to 2012. In spring 2007, the EU heads of state decided to ensure the long-term continuity of the EU ETS by setting an emissions reduction target for 2020. Also in 2007, the EU ETS underwent a review process, which led to an institutional overhaul of the scheme, including issues such as sectoral coverage and allocation method.

Since the EU ETS is the major mandatory trading scheme, it is also the main driver for project-based mechanisms by creating a demand for credits. In 2010, the total CDM market – including primary and secondary transactions – was worth US$19.8 billion (World Bank 2011). Early projects produced credits by reducing industrial gases that had an especially high global warming factor such as HFC-23 and N_2O, often described as "low-hanging fruit." Since 2007, more credits have increasingly resulted from renewable energy and energy-efficiency projects. Since the inception of the CDM market, China has been the largest recipient of CDM funding.

Representing the second pillar of the carbon market, the voluntary market is a credit-based trading market in which credits are generated and sold for non-compliance purposes. In 2010, the voluntary market had a financial volume of only about US$430 million, which is miniscule compared to the total size of carbon markets (World Bank 2011).

The Performance of Carbon Markets

A comprehensive verdict on the efficiency and effectiveness of existing carbon markets is still pending. Here, we offer a provisional assessment of the effectiveness of carbon trading. The available data on the effectiveness of carbon trading are mostly limited to the trial period of the EU ETS (cap and trade) and the CDM (baseline and credit).

The trial period of the EU ETS ran from 2005 to 2007. This first period has been criticized for mainly two flaws (Ellerman and Buchner 2007). First, emissions permits to regulated entities were overallocated (Anderson and Di Maria 2011), due to a lack of accurate emissions data. Once the data were corrected, and the excessively generous allocations revealed, the carbon price plummeted. Second, electric utilities reaped significant windfall profits by passing along the costs of freely allocated allowances. The trial period of the EU ETS thus led to relatively modest emissions reductions (Ellerman and Buchner 2007). The emissions of the sectors covered by the EU ETS flattened during the 2005–2007 period despite robust gross domestic product growth. Hence, the trial period was somewhat effective in terms of reducing CO_2 emissions.

Yet as A. Denny Ellerman and Paul Joskow (2008) argue, the trial period was not meant to lead to significant emissions reductions but rather to establish the trading scheme and provide lessons for reform. The EU ETS in fact delivered on these criteria. It established the market infrastructure and created a carbon price, which companies started to incorporate into their decision-making. In December 2008, the

EU passed a reform package, which aimed to make the system more effective. In particular, it introduced partial auctioning as the allocation method and granted the European Commission stronger authority in the allocation process. The effectiveness of the scheme hinges critically on the ability of member-states and the European Commission to manage the market. The performance of the second trading period so far provides cause for cautious optimism. Anecdotal evidence suggests that higher allowance prices in 2008 led to fuel switching in the power sector and improvements in the efficiency of power plants, which resulted in emissions reductions (Ellerman *et al.* 2010).

The experience with the CDM is similar to that with the EU ETS: it underperformed regarding its environmental outcome, mostly due to design issues. Again, the imperfect performance is not surprising and does not undermine the merit of the instrument *per se*. The criticisms of the CDM relate mostly to its limited scope and the "addititionality" of emissions reductions achieved through CDM projects (Hepburn 2007; Harvard Project on International Climate Agreements 2009).[5] The CDM's limited scope is due to a couple of reasons. First, the approval of CDM projects through the CDM executive board is a bureaucratic and expensive process. Every single project has to go through this approval process in order to receive credits. Second, the CDM initially excluded a number of mitigation activities, such as the conservation of forests. With regard to additionality, there are concerns that some CDM projects would have been conducted in the absence of the CDM – that is, they are not "additional" to what would have occurred under business-as-usual (Schneider 2007).

Linked to this is the issue of what kinds of emissions-reducing projects are funded through the CDM. The CDM was meant to encourage investment into low-carbon energy infrastructure in developing countries (Wara 2007). Renewable energy projects, however, accounted for only 35% of the emissions reductions to be achieved through the CDM until 2012.[6] The largest share of emissions reductions result from capturing and destroying industrial gases such as HFC-23, N_2O, and CH_4 emitted by landfills and confined-animal-feeding operations. Hence, in these cases the CDM credits did not spur investment in low-carbon energy infrastructure. Credits of this type were banned from use in the EU system from the end of 2012. While the shortcomings of the CDM market are significant, a number of analysts suggest that institutional reform could greatly strengthen the mechanism (Victor and Cullenward 2007). The CDM is important as it engages the fastest-growing economies such as China and India in global mitigation efforts.

In sum, both the EU ETS, the first multilateral cap-and-trade scheme, and the CDM, a global baseline-and-credit scheme, produced only modest emissions reductions in the early trial period from 2005 to 2008, when market infrastructure was established and lessons were learned. While a comprehensive analysis remains to be done (to our knowledge), there is a good chance that the carbon-trading schemes will score significantly higher on environmental effectiveness over the 2008–2012 period (Grubb *et al.* 2010).

Conclusion

This chapter has examined the politics and economics of putting an explicit price on carbon dioxide emissions using economic instruments. We observed that carbon-trading schemes have, so far, trumped carbon taxes in the quest for the predominant way to price carbon. In the early 1990s, initiatives to implement carbon/energy taxes in Europe and the USA failed largely due to significant business opposition. In the mid-1990s, international GHG emissions trading emerged on the international agenda, once the USA had insisted on its inclusion in the Kyoto Protocol. We argue that support from some business and environmental groups was important in building momentum for the instrument. Subsequently, the EU – which had previously been opposed to market-based mechanisms – went ahead in implementing the first multilateral trading scheme, the EU ETS. The European scheme was henceforth the backbone of the carbon markets. Other countries in North America and Asia-Pacific followed suit by implementing schemes or kicking off legislative processes on cap-and-trade regulation.

While a large number of economists conclude that carbon taxes are more efficient under uncertainty than emissions trading, for a problem like climate change, emissions trading dominated mostly for reasons of political economy. It is able to garner support from environmental groups (due to environmental certainty), business groups (due to lower transfers to government and to new business opportunities in emissions markets), and from government actors (due to cost-effectiveness and ability to generate some revenue). The allocation of free permits also allowed government to "buy off" various resisting groups. This led to an unusual alliance of actors that promoted or at least accepted trading schemes.

The Kyoto Protocol envisioned a global trading scheme based on an international treaty, which, however, has not yet materialized. Instead, subnational, national, and regional trading schemes emerged in Europe, North America, and Asia-Pacific. Carbon markets thus remain highly fragmented and diverse. They face significant challenges with regard to their governance and market integration. Their economic efficiency and environmental effectiveness depend in particular on the ability of governments and other actors to set emission caps right, to allocate permits efficiently, and to master the information challenges related to measuring, reporting, and verifying emissions. Given the heterogeneity of emerging trading schemes, future market integration will most likely occur in an incremental and messy fashion.

Notes

1 Economists note that although they do not create an explicit price, they do create an implicit, or "shadow," price.
2 See Hepburn (2006) for a comparison of price- and quantity-based regulation.
3 For a summary of the key provisions, see Hepburn and Jotzo (2011).
4 For data on carbon markets, please see the annual *State and Trends of the Carbon Market* report by the World Bank.
5 The term "additionality" refers to the requirement that the emissions reductions are "additional" to emissions reductions that would have happened anyway if the CDM had not been in place.
6 "CDM Pipeline Overview," http://uneprisoe.org/ (accessed January 9, 2012).

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