Introduction

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The current international climate debate is dominated by conflicts about the efficiency and equity effects of the international climate regime with an emphasis on the economic and legal aspects on the one hand, and on the environmental on the other. No balanced compromise over the complex trade-offs that characterize the climate change problem is likely to appear in the short run, irrespective of the results of the seventh climate summit in Marrakesh in November 2001. Marrakesh has kept the international climate change process alive and arguably is a major step towards entry into force of the Kyoto Protocol. But the Kyoto Protocol is only one (small) step on the way to an effective climate policy, which will call for far greater greenhouse gas reductions and the full engagement of the USA and ultimately developing countries.

With these difficulties as background, this book approaches climate change policy from the following perspective: rather than focusing on short-term issues dealing with the implementation of the Kyoto Protocol (ceilings, sinks, monitoring, enforcement, liability and so on), this study looks at the fundamentals of the climate problem. It takes a long-term perspective on climate change and concentrates on identifying incentives both for governments and industry to adopt climate change policies. The book aims to determine whether certain incentives will induce the adoption of a climate policy, and if so, which incentives are provided by different policy instruments. Hence the focus of the study is on the tools that provide incentives for firms and for governments to act in order to reduce or control their greenhouse gas (GHG) emissions. More concretely, the book asks: what are these incentives? How can short-term incentives be combined with long-term incentives? Are there enough incentives also for long-term policies, namely those designed to foster R&D, innovation and its diffusion? The analysis does not stop there, however, but moves on to 'policy mixes'. It finds that incentives to act can be optimized by blending different instruments so that they mutually reinforce incentives. Hence, this study addresses the question: what policy mix is most likely to increase the motivation of firms and governments to act? To answer this question, we will adopt a European perspective on policy making.

Our work focuses on firms and governments. One may argue that this neglects other actors in the climate change arena, for example, NGOs, trade unions and households. However, the book stresses those incentive mechanisms that are likely to provide the most significant results in terms of emissions reductions even in the first commitment period, thus enabling countries to attain the Kyoto targets set in 1997. The role of NGOs and households is certainly important in this process. For example, a change in household consumption patterns could be very effective. Nevertheless, the 2012 objectives are most likely to be achieved if firms and governments are presented with the appropriate incentives to reduce GHG emissions. Moreover, even in terms of burden sharing, this seems to be the most equitable option.

SCOPE OF THE BOOK

This book, composed of five integrated chapters, could logically be divided into three parts. The first part provides an overview of different climate policy instruments from both a theoretical and a historical perspective. Here the goal is to describe the whole set of instruments that governments and firms can adopt to reduce GHG emissions, and to argue in favour of a well-designed policy mix, which would provide the necessary incentives to undertake action. The second part of the book focuses on the behaviour of firms. Implicitly assuming that an agreement can be found by governments, the study analyses which instruments are most likely to induce industries and companies to act to reduce GHG emissions. Action may take the form of negotiated agreements, business opportunities in the trading market, investments implemented within joint implementation (JI) or the clean development mechanism (CDMs). But actions may also take the form of investments in R&D or in new climate-friendly technologies and products. Finally, the third part of the book analyses whether there are actually incentives for governments to achieve agreement on climate change control, and which policy instruments and institutional design are most likely to provide these incentives.

Each chapter concludes with a summary of the main findings. Appendices present a number of case studies supporting the analysis.

The structure of the book is similar to a three-stage (logical) game: in the first stage, governments decide whether or not to implement the Kyoto Protocol (or more generally, a climate treaty); in the second, governments implement the consequent policy mix; and in the third, firms respond to the governments' decisions with their own optimal strategy (independently or through negotiations and different forms of cooperation). As usual, the sub-game

perfect equilibrium is found by solving the game backwards. Hence the book starts from firms' behaviour and ends with the strategic decision facing governments of whether or not to ratify the climate treaty.

Three criteria guide our analysis and comparison of different policy instruments:

- the incentives induced by different instruments and policy mixes;
- the actual historical trends (which seem to lead towards the so-called Kyoto mechanisms); and
- the practical compatibility of the Kyoto mechanisms with traditional environmental instruments, notably regulation, voluntary agreements and taxation, which have served as the backbone of environmental policy to date.

Against the background of the historical trends of, first, increasing diffusion of incentive-based instruments and, then, a combination of different instruments, the first chapter, written by Christian Egenhofer, addresses the issue of the compatibility of instruments to address climate change and policy mixes. It concentrates on the linkages between flexible mechanisms, notably emissions trading on the one hand and voluntary agreements, regulation and taxation on the other. It also concentrates on the potential incompatibility between domestic and international emissions trading, and explores ways of addressing these. It takes a practical approach. Rather than reviewing the results of theoretical models of the relative merits of different instruments, the first chapter reviews the literature on past experiences with the Kyoto mechanisms, defines the design options that could make these fit together, and evaluates a number of proposed or already running programmes as to how they would eventually fit with existing environmental policies. This chapter provides an analysis of design options that not only ensure compatibility but 'optimize' existing policy mixes.

The second chapter, by Patrick ten Brink, Marina Morère and Jane Wallace-Jones, analyses the incentives that firms have in adopting climate-related voluntary agreements. These voluntary agreements (or negotiated environmental agreements, NEAs) can be seen as a first step towards a more cost-effective and environmentally efficient policy. Either they are useful for negotiating the targets for the subsequent implementation of trading schemes, or they directly tackle the goal of emissions reduction by exploiting business opportunities (green consumerism). Alternatively, they aim to smooth the impacts of direct regulation or of other more costly (from the viewpoint of firms) environmental policies. What are the risks and rewards of adopting NEAs, and in particular what are the incentives for companies to participate in environmental agreements, and what are the incentives for action once

companies become official participants? How can the environmental and economic impacts of NEAs be assessed? And what can one say, given current data availability? What are the costs of implementing the NEAs (for example, transaction costs)? Can NEAs be effective as stand-alone policy instruments, or is their effectiveness linked to the portfolio of policy instruments that governments use to address climate change? The second chapter tackles these questions and shows how voluntary agreements should be designed to provide the right incentives for firms to adopt them without losing their environmental effectiveness.

A similar approach is adopted in Chapter 3, in which Josef Janssen explores opportunities and barriers associated with the Kyoto mechanisms for industry. It focuses on two different categories of industry: the first type encompasses those companies that will act as final buyer or supplier of GHG emissions permits; the second type includes financial institutions. Chapter 3 provides a deeper understanding of both the general potential of the Kyoto mechanisms in terms of cost savings and business opportunities, and the barriers potentially hampering their application by industry. It also provides a comprehensive analysis and description of business opportunities, starting from a general assessment of the size of the market and ending with an analysis of the role of financial institutions.

The fourth chapter of this book, by Marzio Galeotti and Carlo Carraro, takes a longer-term perspective and focuses on the incentives for firms to undertake climate-related R&D and investments. This opens the way to an analysis of the dynamic efficiency of different policy instruments. Hence this chapter looks at the effect of environmental policies on the development and spread of new technologies, which, in the long run, may be the most important determinant of success or failure in climate change control. The chapter starts with an overview of the theoretical literature on the dynamic effects of environmental policy instruments on technological change, followed by the study of the role of policies in empirical set-ups. In particular, the chapter focuses on climate change models which explicitly incorporate a specification of technical change and diffusion. There, the working of flexibility mechanisms – international emissions trading in particular – alongside traditional policies and measures, is analysed. The results show how Kyoto mechanisms can play a double role. On the one hand, they minimize abatement costs in a static framework. On the other, they provide adequate incentives for investments in R&D and innovation.

The last chapter of this book, by Carlo Carraro and Marzio Galeotti, moves up along the game tree and analyses governments' incentives to ratify or to reject the Kyoto Protocol. Again, these incentives are highly modified by the actual climate policy that will be implemented. Hence the basic question is whether there are strategies that could enhance the prospects of the Kyoto

Protocol being implemented by a large group of highly polluting countries, and whether these are strategies that would induce countries to adopt emissions reduction policies even after the first commitment period. To answer these questions, it is crucial to identify which policies can be designed to lower the costs and increase the incentives to ratify a given international agreement on climate. This adds another dimension to the policy discussions of the previous four chapters of the book. Indeed, whereas the previous chapters focus on the environmental and cost-effectiveness of alternative policy mixes, Chapter 5 focuses on the effectiveness of different policy mixes in determining and increasing the number of countries that ratify and implement the Kyoto Protocol.

The importance of the structure of the prevailing international regime and its bi-directional links with the costs and benefits of different policy mixes leads to a second set of issues. If a larger number of participating countries reduces the implementation costs, thus opening the way to further extensions of the Protocol, what are the negotiating strategies that could help increase the number of countries willing to sign and ratify the Kyoto Protocol? Are there negotiating and institutional rules that favour countries' participation? Are there policy strategies that could provide the right incentives for countries to participate in the agreement? More specifically, should negotiations focus only on climate change policies or should they be linked to other policy issues? How can transfers help expand a coalition? The overall findings are discussed in the next section.

MAIN FINDINGS

Chapter 1 begins with an analysis of the long-trend shift from traditional command-and-control instruments towards incentive-based instruments in the European Union. This shift has been influenced by a diversity of motivations including economic (for example cost-effectiveness), sociopolitical (for example political acceptability), environmental (for example implementation and enforcement) or legal (for example competencies). This shift in government policies is also reflected in a shift of position by the regulated firms. While firms' behaviour under command-and-control regimes consisted of cost-avoidance strategies, the shift towards incentive-based instruments is mirrored by companies exploiting the environment in search of markets for new products to gain a competitive edge. The long-trend shift is advancing unevenly from one country to another, depending *inter alia* on the political conditions, the legal system, national preferences, the nature of the environmental problem and different environmental priorities. For example, while tradable permits have played a minor role in the EU, voluntary initiatives and

negotiated agreements have flourished. In the USA, there has been more interest in tradable permits.

At the same time that policy is shifting towards the use of incentive-based instruments, we are also witnessing a decided shift towards combining instruments. Originally motivated by governments' desire to apply the most appropriate instrument to a given environmental problem, policy mixes are increasingly a result of practical solutions to a government's need to accommodate the 'real world', that is, to build on existing policies and instruments, whether taxation, regulation or NEAs. An example of this phenomenon are the newly emerging climate policies within the framework of the Kyoto Protocol, which has introduced three genuine international market-based instruments: international emissions trading, joint implementation and the clean development mechanism (IET, JI and CDM) for governments to use and combine with domestic policies into new policy mixes. Although there is a risk that policy mixes increase transaction costs,¹ they are increasingly designed to 'optimize' incentives for action. A good example is the combination of NEAs and emissions trading. While NEAs are seen as low-cost and flexible instruments, allowing for emissions trading in addition (as is proposed in the UK) will further increase both efficiency and effectiveness. There are a number of examples (see also Chapter 2), where the threat of regulation or taxation is meant to 'persuade' industry to negotiate an NEA (for example in Denmark, Germany, Belgium, the UK). The experience gained from negotiating and setting targets (for example benchmarking) from an NEA is expected to increase the incentives of firms to accept a cap-and-trade scheme. NEAs generally improve the knowledge of both the regulator and the regulated firm on real abatement potential and its costs.

Chapter 1 discusses in particular the role of the relative merits of different emissions trading programmes with a view to combining them with other instruments, notably NEAs. The economic literature expresses a clear preference for allowance (or cap-and-trade) emissions trading as opposed to baseline-and-credit programmes (or credit-based trading).² Allowance trading programmes have the double advantage over credit trading schemes in that they ensure environmental effectiveness and tend to have fewer transaction costs. These were the two main reasons why the US EPA, which implemented most actual emissions trading schemes, has moved over time from credit trading to cap-and-trade schemes, which by now can be said to be the 'traditional' approach. This contrasts with the situation in Europe, where numerous voluntary or negotiated agreements between government and industry exist that have set relative or specific targets. The main advantage of credit trading is that it can be combined at the same time with policies based on absolute and relative performance such as in NEAs and a mix thereof, which is the reality in Europe. Only rate-based credit trading programmes are

compatible with the ‘European model of voluntary approaches’. France and the UK but also Canada have started to experiment with policy mixes that blend cap-and-trade emissions trading with baseline-and-credit schemes (both of which are based on absolute and relative targets). The UK scheme for emissions trading is particularly interesting since it attempts to combine the two forms. Chapter 1 concludes that the advantages or disadvantages of allowance and credit trading in a ‘real-world’ setting are not absolute and can be addressed by institutional design, although the existing economic literature has paid little attention to this.

Baseline-and-credit programmes have the further advantage that they might be politically more acceptable³ due to the fact that credits – unlike permits in allowance schemes that are allocated, most often for free – must be earned by demonstrating better-than-mandated behaviour. In this way, credit schemes can overcome popular criticism that allowance trading gives participants a ‘licence to pollute’. Some maintain that credit trading avoids the contentious issue of initially allocating allowances and may therefore be more equitable than cap-and-trade systems with grandfathering. There is, however, very little discussion of the equity issues of emissions trading schemes. One should expect that equity considerations are likely to dominate the debate on emissions trading in the coming years.

Chapter 2 takes an in-depth look at the role of voluntary or, as they are called in Europe, negotiated environmental agreements (NEAs), both as a single instrument and as part of a policy mix. The overall conclusion is that NEAs are increasingly seen as offering a pragmatic and potentially valuable instrument to help address climate change. In several countries NEAs have been chosen by governments to be an important instrument to meet the Kyoto targets (for example France, the Netherlands, Italy and Germany – at least under the last government). However, the chapter also shows that significant further efforts will be required to ensure that the NEA tool can fulfil this promise and responsibility.

The theoretical analysis and the case studies reveal a number of emerging *patterns* regarding NEAs. First, an increasing number of countries look to NEAs. For some countries, they are the main instruments (for example Germany, the Netherlands and Italy), while in others, NEAs are often a significant part of a portfolio of instruments. Second, governments see NEAs as a means to preserve competitiveness of domestic firms. NEAs are perceived as a least-cost and flexible alternative to other instruments such as taxation or regulation.⁴ Third, NEAs are increasingly integrated with emissions trading or the Kyoto mechanisms (for example in the UK and the Netherlands). Fourth, there is an increasing demand for more mature NEAs that are credible and offer a real potential to be successful. Early and somewhat weak NEAs have sometimes discredited the instrument, risking

taxation or regulation instead, and generally could not guarantee certainty to business.

Early NEAs have entailed some degree of *regulatory capture*, but pressure by the public and NGOs led to more realistic and demanding targets. There is no conclusive evidence on the impact of NEAs. They are a relatively new instrument still under construction, and tend to be directed to the long term. Improving monitoring and measuring will be important in this respect.

The *linkage* to emissions trading and eventually the other Kyoto mechanisms will play an important role, although the nature and extent of this role will only become fully clear in the future (see also Chapter 1). To date, few NEAs are explicitly linked to emissions trading schemes and the Kyoto mechanisms. Some NEAs are linked to permitting (the Netherlands) and some to tax exemption (Denmark and the UK). Subsidies and regulation (for example standards or requirement for audits) are also usually linked to NEAs. It is clear that NEAs cannot realistically – without linkage to other instruments, and at least incentives and sanctions – offer any significant benefits in the area of emissions reduction and meeting GHG emission reduction targets.

It is far from clear at this stage whether NEAs are just a transition measure to address climate change or whether they will become the standard instrument, integrated into the portfolio of instruments designed to address climate change. While NEAs have the potential to become a long-term instrument, much depends on their achievements, on the culture and country-specific contexts, and on the institutional structure that develops around the climate change issue. Their future also depends on the actual motivation (and success) of stakeholders in the continued process of revision and improvement of NEAs. Finally, the uptake depends on the level of international commitment to and collaboration in combating climate change. It is clear at this stage, however, that the climate change NEAs can serve a real learning and regulatory capacity development role, but without clear and quantitative early successes that are identified and communicated through more credible monitoring schemes, the tool is unlikely to live up to its declared potential. To the contrary, in fact; it might instead live up to its threat of being a tool for exemptions rather than a tool for action.

Chapter 2 argues that it is impossible to judge the potential of an NEA without looking explicitly at specific sectors and the country-specific context. It concludes by posing a set of questions that need to be answered when the choice is made.

Chapter 3 takes a different angle in its analysis of business opportunities and barriers with respect to the use of flexible mechanisms as defined in the Kyoto Protocol. The role of firms is likely to become increasingly important in the emerging international regime governing climate change. From the outset, the international regime has focused on market-based solutions driven

by economic incentives rather than regulation. The practical implications of the analysis developed in Chapter 3 are necessarily preliminary. Whether the Kyoto Protocol will be ratified or implemented at this stage – even after the conclusion of the seventh Conference of Parties (COP7) in Marrakesh – remains unclear. Similarly, unless the US role is clarified, any empirical analysis must remain preliminary. However, irrespective of the details of an international agreement including US participation, it is clear that both national and international emissions trading will play a key role in any future climate policy regime at the national, regional or international level. Although the lack of certainty about the international regime strongly affects the quantitative results, such as the size of the markets, it does not fundamentally affect the analysis of opportunities and barriers in principle.

This chapter reiterates the argument put forward in the previous two chapters (but from a company perspective) that governments might wish to implement a mix of different climate policies, thus not relying exclusively on allowance trading. It confirms that inventory-based emissions trading, or allowance trading, will be complemented by project-based emissions trading (baseline-and-credit trading) in those industries and sectors that are not regulated by allowance trading, but other policy instruments such as energy efficiency standards or negotiated environmental agreements (see Chapter 2 on the latter) will also play a role. Joint implementation and the clean development mechanism may then be interpreted as international baseline-and-credit trading.

The first and most basic opportunity is on the demand side of GHG markets and mainly involves significantly lower costs of compliance for industries that are regulated by climate policies. Companies with comparatively low abatement costs may benefit from emissions trading and the other Kyoto flexible mechanisms by marketing any surplus emissions reductions, thus making additional profits. Indeed, the value of the *international* market for emissions permits is estimated to amount to several tens of billions of dollars annually.⁵ In addition to international markets, emerging national markets will provide good opportunities to sell profitably surplus emissions permits.

The main barriers that prevent companies from taking advantage of GHG emissions trading and the other Kyoto mechanisms are identified as market risks and regulatory barriers at the international and national level. Important market risks include uncertainties about the price of permits and liquidity risks. Regulatory barriers induced by international rules include possible import restrictions, levies on transactions, and eligibility requirements for countries. At the national level, the low compatibility of domestic climate policy regulations with the Kyoto mechanisms and the lack of incentives for market participants to engage in the Kyoto mechanisms may represent major barriers. The latter issue is also addressed in Chapter 1.

Price risks may be managed through derivatives. In contrast, regulatory barriers need to be removed through appropriate design of climate policies and regulations. In particular, governments need to provide incentives for private-sector companies to use the Kyoto flexible mechanisms for compliance. To this end, companies that apply the Kyoto mechanisms should be relieved from obligations incurred by domestic climate policy regulations by a corresponding amount. Transparent and stable regulations governing the Kyoto mechanisms are essential for their use by the private sector.

Financial institutions may be expected to facilitate market development and to enhance the efficiency of GHG markets. At present, the role for commercial insurance is rather limited since many risks in emerging GHG markets are regulatory, political or market risks, which are difficult to insure. In contrast, carbon investment funds have the potential to hedge some risks associated with investments in abatement activities that aim to result in marketable emission permits. Such funds may be set up and managed by investment banks and other financial institutions. Indeed, some carbon funds are already emerging in reality.

Chapters 1, 2 and 3 focus on short-term actions taken by a single industry or firm. In Chapter 4, the analysis covers incentive mechanisms that may also lead to effective emissions reductions in the long run, by stressing the role of climate-related technical change and by analysing which incentive mechanisms can be designed to foster its adoption and diffusion. In particular, Chapter 4 identifies which policy mixes are most suitable to induce firms to adopt long-term innovation policies aimed at reducing GHG emissions.

The perspective chosen in Chapter 4 is both a microeconomic and a macroeconomic one, because it also takes into account the systemic effects of growth and innovation, including their links with environmental degradation. Hence the impact of different climate policies on growth has been considered jointly with their impact on innovation and emissions.

Chapter 4 stresses that an understanding of the process of technological change is essential to any economic analysis of environmental issues. This is true for two main reasons. First, the environmental impact of social and economic activity is greatly affected by the rate and direction of technological change. This linkage occurs because new technologies may either create or mitigate pollution, and because many environmental problems and policy responses are evaluated over periods of time in which the cumulative impact of technological change is likely to be large. This observation is a natural bridge to the second broad linkage between technology and environment – the effect of environmental policy interventions on the process of technological change. The empirical evidence presented in Chapter 4 is generally consistent with theoretical findings that market-based instruments for environmental protection are likely to have significantly greater, positive impacts

over time than command-and-control approaches on the invention, innovation and diffusion of desirable, environmentally friendly technologies.

The potential long-run consequences of today's policy choices (for example policy-induced incentive mechanisms) create a high priority for broadening and deepening our understanding of the effects of environmental policy on innovation and the diffusion of new technology. Unfortunately, these issues cannot be resolved at a purely theoretical level, or on the basis of aggregate empirical analyses. For both benefit–cost and cost-effectiveness analysis, modern economics relies on a set of powerful analytical and computational tools that support quantitative modelling of economy- and society-wide policies over the long run. In practice, such analysis is typically carried out through the construction and application of large-scale computer models that combine scientific and economic theories and data into unified quantitative frameworks. These ‘integrated assessment’ models have emerged as decision makers’ primary tool for quantitative climate policy analysis.

Only a handful of such recent models, which are reviewed in Chapter 4, have tackled the difficult issue of explicitly modelling the process of technical change. Most of them have then been applied to study the effects of the implementation of the Kyoto Protocol, particularly as far as the consequences of the emission targets and of the Kyoto mechanisms are concerned. Chapter 4 shows that in those models in which technical change is better designed, the Kyoto mechanisms have a relevant impact on the incentives to carry out R&D and to develop energy-efficient technologies. In addition, emissions trading provides incentives for a strategic use of R&D, that is, R&D is also undertaken for the profit opportunities provided by trading emissions internationally. It is in addition shown that constraints on the use of the Kyoto mechanisms are of no help in increasing R&D and technical change.

The policy implications that can be drawn from the analysis presented in Chapter 4 hinge on the following basic conclusion: technological innovation and diffusion are the main engine of growth. Growth is correlated with increasing environmental efficiency. Hence innovation accomplishes a two-fold task: it stimulates growth and competitiveness and reduces pollution levels.

However, several market failures characterize existing innovation systems. Spillover effects, inefficiency in the banking sector and financial markets (which have the task of channelling the funds to finance innovation), risk aversion, the nature of knowledge as a public good, and lack of coordination are all elements that reduce private incentives to undertake R&D and innovation and call for public intervention. These market failures are even stronger in the case of international and global environmental problems, for example climate change. Climate change is a global, long-term, uncertain phenom-

enon. These features crucially reduce firms' incentives to undertake R&D and innovation. Therefore policy measures are necessary. These policies – usually policy mixes based on a bundle of instruments, as shown in Chapter 4 – can be undertaken both nationally and internationally.

At the national level, the long-term dimension of climate change calls for action on R&D and innovation that enhances *long-run competitiveness* in environmentally sensitive sectors, increases *financial resources* provided by the banking sector (for example by partly involving banks in the liability process), guarantees *protection* for energy-efficient innovation (for example by introducing a climate-related licence policy), and supports *cooperation and research joint ventures* designed to undertake environmental R&D.

At the international level, another dimension of the problem must be taken into account. As further emphasized in Chapter 5, the global dimension of climate change and the increasing mobility of capital and goods call for action in both developed and developing countries. According to the analysis developed in Chapter 4, it is therefore crucial to increase:

- the diffusion of knowledge by disseminating information about new environmentally friendly technologies;
- basic learning and innovation by stimulating interactions between academic research and applied environmental innovation; and
- the diffusion of technology by improving the quality of the role of multinationals in the global economy and by implementing technological cooperation agreements.

In this framework, environmental innovation policies are structurally linked and interact with competition, industrial and trade policies. These should support R&D cooperation, increase the competitiveness of the banking system, protect innovation and introduce lender liability schemes, and support trade rules that favour technology transfers.

As stated above, the objective of Chapter 5 was to answer a set of questions which are crucial for understanding the future prospects of climate negotiations. In particular, the goal was not to understand whether the Kyoto Protocol is going to be ratified and implemented, but whether an *environmentally effective* climate agreement, possibly based on the Kyoto framework, is going to be adopted in the near future. Therefore the basic questions addressed in Chapter 5 are as follows: given the peculiar features of the climate change problem, what is the future of the United Nations Framework Convention on Climate Change (UNFCCC) and of the Kyoto Protocol? Is there any strategy that could enhance the chances of implementation of the Kyoto Protocol, and its extension beyond 2012, by the USA and other major polluters? Or should countries move to a different type of agreement, as recently suggested in the USA?

In answering these questions, Chapter 5 analyses which policy strategies and negotiation rules can help increase the number of countries engaging in a long-term international agreement to combat climate change by signing and ratifying the Kyoto Protocol and its possible extensions after 2012. This analysis identifies a set of policy guidelines that could help the future evolution of climate agreements.

Before summarizing these policy guidelines, it is important to stress a methodological point put forward in Chapter 5. Given the strict interdependence between the costs and benefits of different policy options (that is, the timing of optimal responses to climate change, the choice between mitigation and adaptation responses, the role of technological innovation and diffusion, the choice between domestic action and the adoption of ‘flexible mechanisms’, the importance of secondary benefits, and so on) and the characteristics of the international agreement on climate change that is adopted (for example the number of signatories, the size of their quantitative commitment to control GHG emissions), it is impossible to assess the costs and benefits of the Kyoto Protocol, or of other potential agreements on climate change, independently of the number of signatories to the agreement and of their abatement targets and/or policy commitment. But at the same time the number of signatories is endogenous and depends on the abatement targets and mitigation policies adopted in various countries. Hence it is important to analyse the environmental and cost-effectiveness of climate policy jointly with a country’s decision to sign and ratify the agreement. Hence the analysis of which strategies can be proposed to reduce the costs of mitigation policies becomes quite different from the ones usually proposed in recent papers on climate policy (see Table 5A.1 in Appendix 2 of Chapter 5). The reason is that a country’s goal is not only to identify a new climate-friendly technology or an adequate redistribution of costs across sectors. An important goal is also to affect other countries’ behaviour in order to increase the number of countries sharing the burden, and the equity with which this burden is shared.

From this perspective, two main policy dimensions are identified in Chapter 5. The first moves from domestic and rigid (for example norms and measures) policies to global and increasingly flexible policies. The second moves from unilateral to increasingly cooperative actions. Chapter 5 emphasizes that it is not necessary to achieve the optimum along both policy dimensions. For example, even a suboptimal distribution of targets across countries can be consistent with optimal emissions reduction schemes if coupled with a global and flexible policy (for example a global system of emissions trading).

Chapter 5 also shows that it is quite difficult to characterize as ‘likely’ a scenario in which either a global coalition forms or a global and perfectly competitive emissions trading system is implemented. Hence we are left with

a world in which only a subset of countries may decide to commit themselves to emissions control and only a subset of countries, not necessarily the same countries, may decide to participate in a freely competitive trading system. In this latter scenario, there are three policy options:

1. Design policies that induce countries that are not committed to emissions control to accept this commitment. This can be done through appropriate policies that, on the one hand, reduce the cost of the commitment (for example competitive emissions trading again) and on the other hand increase the benefit of the commitment by means of transfers or by linking the climate agreement to other economic agreements (for example on technological cooperation).
2. Recognize that most countries' main incentive is to form several coalitions that may adopt different policy measures. In this case, instead of a single global agreement, countries should be free to negotiate regional climate agreements. In this setting, it may be reasonable to pursue a climate agreement within the EU or between the EU, Eastern Europe and former Soviet republics, because other regional climate agreements are likely to emerge subsequently. Once several regional agreements enter into force, for example in Europe, East Asia and the Americas, then the three groups of countries can negotiate to achieve a global agreement.
3. Focus on treaty design and investigate whether there are negotiation and accession rules that could increase the incentives to sign and ratify a climate agreement.

Chapter 5 also addresses the equity issue. In particular, this chapter has analysed the conjecture that a more equitable distribution of the burden of reducing emissions could provide the right incentives for more countries – particularly long-run big polluters (for example the USA, China, India) – to accept an emissions reduction scheme defined within an international climate agreement. Chapter 5 only partly supports this conjecture. Even though more equitable burden-sharing rules provide better incentives to sign and ratify a climate agreement than the burden-sharing rule implicit in the Kyoto Protocol, a stable agreement cannot generally be achieved; that is, equity seems to enhance the profitability of an agreement but it does not offset the incentives to free-ride.

Therefore, Chapter 5 also analyses whether there exists a transfer mechanism that could help broaden an initially stable, but partial, coalition based on an agreement on an equitable burden-sharing scheme. Our results suggest that transfers can indeed help broaden a given coalition. However, the grand coalition could not be achieved with merely the three equity rules considered in Chapter 5 (equal average abatement costs, equal per capita abatement costs

and equal abatement costs per unit of GDP). The only strategy that could achieve a global agreement without free-riding incentives is a policy mix in which global emissions trading is coupled with a transfer mechanism designed to offset *ex-post* incentives to free-ride. This policy mix can achieve a stable global agreement whatever the initially stable coalition and whatever the *ex-ante* burden-sharing rule.

As a consequence, Chapter 5 seems to suggest that an excessive focus on *ex-ante* equity rules is not fruitful. It is more effective to minimize overall abatement costs via emissions trading and then to use the resulting surplus to provide incentives for free-riding countries to join the initial coalition.

By combining the insights derived by analysing the efficiency of climate policies with those related to their equity, Chapter 5 leads to some basic policy guidelines:

- Policies, mainly policies that support research on climate change, should reduce uncertainty concerning climate phenomena, their origin and their impact (in particular the distribution of this impact).
- Policies should redistribute benefits from climate change control to make a climate agreement profitable to all participating countries. Relevant redistributive effects can be achieved both through the Kyoto mechanisms and through direct transfers or economic cooperation.
- Policies should address the free-riding incentives by focusing on equity, but also by implementing a wide range of transfers and linkage strategies.
- In the absence of supranational institutions to regulate emissions reductions and in the presence of strong negative incentives to participate in the climate agreement, negotiations should allow for regional and/or domestic cost-effective attempts to control GHG emissions (for example regional or domestic negotiated agreements or trading schemes).
- Policies should support the development of cheaper climate-friendly technologies and their diffusion through negotiated agreements and incentive mechanisms based on detailed policy mixes.
- Climate policies should not be undertaken independently of other economic policies. The best results on climate change control can be achieved by designing trade policies, industrial and R&D policies, insurance and competition policies, patent and property rights policies, technological cooperation and international monetary policies, with a view to climate issues and with a clear understanding of the climate-related benefits that these policies, if appropriately designed, can achieve.

NOTES

1. This is for example the case of the so-called 'gateway' in the UK emissions trading scheme (see Appendix 1 in Chapter 1), which avoids carbon leakage but increases transaction costs.
2. For definitions and a discussion of the differences, see Chapters 1 and 3.
3. There is some evidence for this in France.
4. This view is increasingly challenged by the emergence of emissions trading.
5. This figure is derived from models where the USA is a signatory to the Kyoto Protocol.