Climate and Trade Policy

ESRI STUDIES SERIES ON THE ENVIRONMENT

In April 2000 the Japanese government launched a series of comprehensive, interdisciplinary and international research projects called 'the Millennium Projects' and as part of this initiative the Economic and Social Research Institute (ESRI) of the Cabinet Office of Japan initiated a two year project entitled 'A Study on Sustainable Economic and Social Structures in the 21st Century', which focuses on ageing and environmental problems in the Japanese and international context.

The *ESRI Studies Series on the Environment* provides a forum for the publication of a limited number of books, which are the result of this international collaboration, on four main issues: research on solid waste management; the analysis of waste recycling and the conservation of resources and energy; research on the compatibility of environmental protection and macroeconomic policy; and the analysis of problems related to climate change. The series is invaluable to students and scholars of environment and ecology as well as consultants and practitioners involved in environmental policymaking.

Titles in the series include:

Eco-Efficiency, Regulation and Sustainable Business
Towards a Governance Structure for Sustainable Development
Edited by Raimund Bleischwitz and Peter Hennicke

Achieving a Sustainable Global Energy System
Identifying Possibilities Using Long-Term Energy Scenarios
Leo Schrattenholzer, Asami Miketa, Keywan Riahi and Richard Alexander Roehrl

Climate Policy and Trade Policy
Bottom-up Approaches Towards Global Agreement
Edited by Carlo Carraro and Christian Egenhofer

Corporate Governance of Sustainability
A Co-evolutionary View on Resource Management
Edited by Raimund Bleischwitz

Sustainable Automobile Transport
Shaping Climate Change Policy
Lisa Ryan and Hal Turton

Climate and Trade Policy

Bottom-up Approaches Towards Global Agreement

Edited by

Carlo Carraro

Professor of Econometrics and Environmental Economics, University of Venice and Research Director, Fondazione Eni Enrico Mattei (FEEM), Milan and Venice, Italy

Christian Egenhofer

Senior Fellow, Centre for European Policy Studies (CEPS), Brussels, Belgium and Senior Research Fellow, Centre for Energy, Petroleum and Mineral Law and Policy, University of Dundee, UK

ESRI STUDIES SERIES ON THE ENVIRONMENT

Edward Elgar
Cheltenham, UK • Northampton, MA, USA

Published by
Edward Elgar Publishing Limited
Glensanda House
Montpellier Parade
Cheltenham
Glos GL50 1UA
UK

Edward Elgar Publishing, Inc.
William Pratt House
9 Dewey Court
Northampton
Massachusetts 01060
USA

A catalogue record for this book
is available from the British Library

Library of Congress Cataloguing in Publication Data
Climate and trade policy : bottom-up approaches towards global agreement/ edited by Carlo Carraro and Christian Egenhofer.
p. cm. — (ESRI studies series on the environment)
Includes bibliographical references and index.
1. Environmental policy. 2. Commercial policy. 3. Pollution—Economic aspects. 4. Climatic changes—Economic aspects. I. Carraro, Carlo. II. Egenhofer, Christian, 1960–
HC79.E5C593 2007
363.738′74—dc22
2006101923

ISBN 978 1 84720 227 7

Printed and bound in Great Britain by MPG Books Ltd, Bodmin, Cornwall.

Contents

Figures

Tables

Contributors

Barbara Buchner, Fondazione Eni Enrico Mattei

Carlo Carraro, University of Venice and Fondazione Eni Enrico Mattei

Enrica De Cian, University of Venice and Fondazione Eni Enrico Mattei

Christian Egenhofer, Centre for European Policy Studies and University of Dundee

Noriko Fujiwara, Centre for European Policy Studies

David Kernohan, Centre for European Policy Studies

Foreword

The world at the beginning of the twenty-first century must place the highest priority on constructing a sustainable socio-economic system that can cope with the rapid ageing of populations in developed countries and with the limited environmental resources available in both developed and developing countries. At first glance, the problems of ageing and the environment may seem to be quite separate issues. However, they have a common feature: both deal with intergenerational problems. The essence of the ageing problem is how to find effective ways for a smaller working generation to support a larger, ageing generation. The crux of the environmental problem is to find a feasible way to leave environmental resources to future generations. Moreover, in terms of consumption, slower population growth may slow consumption and alleviate environmental problems. On the other hand, a rapidly ageing society may use more energy-intensive technology to compensate for the inevitable labour shortage, and deteriorate the natural environment by doing so.

Today, these concerns are highly applicable in Japan. The pressure created by the rapid ageing of the Japanese population is becoming acute; Japan must construct a sustainable society that does not create intergenerational inequity or deteriorate the public welfare. At the same time, Japan cannot deplete its environmental resources and energy, which would leave future generations with an unbearably heavy burden.

The government of Japan has recognized the vital importance of both problems. As a part of the projects that explore and implement solutions for the ageing and energy problems, the Economic and Social Research Institute (ESRI), Cabinet Office, Government of Japan, initiated a two-year project entitled 'A Study on Sustainable Economic and Social Structures in the 21st Century' in 2000 and its follow-up project in 2002, placing major emphasis on social science. While taking into account technological innovation and feasibility, they focus on ageing and environmental problems. They aim to design a desirable socio-economic structure under the pressure of an ageing population and environmental constraints by identifying the necessary policy tools to attain stable and sustainable growth.

These projects are being implemented with close collaboration among Japanese as well as foreign scholars and research institutes. Besides Japanese scholars and institutes, foreign participants have been involved

from, among other countries, the USA, the UK, Norway, Austria, Italy, Australia, Korea and Thailand. In all, there are ten countries and 30 working groups.

In this follow-up project, the ESRI explores optimal solutions to problems in social science terms. After taking into account the political and social constraints we face, and after alignment and coordination with the results of the studies, it sketches an ideal design and examines the possible direction of future research. The follow-up project concluded in March 2004. It resolved many theoretical and empirical issues, but has created new debates. Once a year, all the participants in the project, along with invited others, meet to discuss the results of the research.

Overall, the papers presented in the project were extremely challenging, and covered a wide range of topics. In the near future we strongly hope we will have a chance to discuss the research once more from a common standpoint. The result of this research is published by Edward Elgar Publishing Ltd as part of an ESRI study series, available to policymakers, academics and business people with a keen interest in these subjects. The series on environmental problems covers climate change, sources of energy and technology, and environmental and employment policy. Unfortunately, because of space limitations, we are able to publish only selected papers from the total research effort. The research papers to be published were selected by the Editorial Board members. We would like to acknowledge the ceaseless efforts of the members of the ESRI throughout the project period, especially those of the Department of Administration Affairs. Last but not least, we would like to thank Dymphna Evans from Edward Elgar Publishing.

Masahiro Kuroda, President ESRI

1. Bottom-up approaches towards a global climate agreement: an overview

Carlo Carraro, Christian Egenhofer and Noriko Fujiwara

Despite almost 15 years of negotiations to achieve and implement a global climate change agreement, the international community appears to be still some way from a breakthrough. Largely diverging views on a fair and politically feasible and yet effective agreement continue to lurk under the surface of the United Nations Framework Convention on Climate Change (UNFCCC) negotiations, but have also become apparent during the implementation of the Kyoto Protocol and domestic climate change policies. While it is true that other international agreements – witness the difficulties multilateral trade negotiations have encountered – and multilateral environmental agreements in particular tend to face similar complications, a global climate change agreement features a number of peculiarities that make an agreement especially thorny. Carraro and Galeotti (2003) have identified seven peculiar features that distinguish a global climate change agreement from any other multilateral environmental agreement. The problem is global; this implies that climate change control is a public good, providing a strong motivation for free-riding.[1] The long-term nature of climate change necessitates taking into account not only long periods – sometimes stretching over half a decade or even beyond – but also dealing with intergenerational transfers that any regulation implies. There exist no narrowly defined technological solutions as in the case of the Montreal Protocol to phase out ozone-depleting substances. Greenhouse gas (GHG) emissions and their reductions affect in a fundamental way all economic activities including agriculture, transport, manufacturing and services, and by extension our lifestyles. Climate change measures exhibit strong interactions with other parameters such as population and economic growth, rate of technological progress, competitiveness or co-benefits such as reduction of local pollution, energy security, technology leadership or even employment. Quantitative and

even qualitative measurement in the past has proven to be difficult. The climate change problem is surrounded by pervasive uncertainty. While there is a global consensus that we know enough to justify action, there is disagreement on almost every other aspect, notably on the rate of climate change, the necessary level of stabilization of concentrations, impacts and their probabilities, mitigation and adaptation costs, and even on the causes of climate change. As with many other global bio-geochemical processes, climate change has long timescales, while changes if they occur most likely will be non-linear and irreversible. Last but not least, there is no global institutional framework able to deal with the many complexities associated with climate change. While many of the above features are equally true for other cross-border – be they global or regional – environmental issues, the climate change challenge has higher intensity and stronger interactions.

Although sometimes hailed as such, neither the UNFCCC nor the Kyoto Protocol yet amount to a credible long-term comprehensive approach towards meeting the UNFCCC goal of stabilization. They are merely a first step to address the climate change challenge, possibly important stepping stones, or at best a crucial element of any future agreement. That the Kyoto Protocol has been rejected by the US and Australia and that it *de facto* exempts fast-growing developing countries from a hard carbon constraint make a straightforward extension of the treaty (that is, Kyoto II) environmentally ineffective as well as economically costly. Capping only one-third of global emissions – as the Kyoto Protocol did in practice – will increase total compliance costs as a result of foregone low-cost options in the other two-thirds.

On the other hand both the UNFCCC and the Kyoto Protocol have established numerous areas where international consensus has emerged or at least appears to be achievable: (1) differentiation; (2) a comprehensive approach to all emission sources; (3) gradualism; (4) flexibility; and (5) flexible mechanisms, that is, the importance of carbon or emissions markets.

While differentiation ('common but differentiated responsibilities') has been part of international environmental law since the entry into force of the UNFCCC, the Kyoto Protocol has reinforced it and attempted to make it operational. The Kyoto Protocol also addresses the problem of climate change in a comprehensive way by including six gases, and 'carbon sinks' such as forests and farmland, which are capable of absorbing GHGs. Similarly, the Kyoto Protocol has acknowledged the need for a gradual approach, that is, modest initial commitments, although the definition is open to interpretation. Gradualism is coupled with flexibility to accommodate the complexity and peculiarities of a global climate

change agreement: global nature, long-term character, unavailable technological solutions, strong interaction, uncertainty, potential irreversibility and the absence of an effective global governance system. Flexibility can take the form of multiple-year commitment periods, banking or sinks. Finally, the Kyoto Protocol has firmly established the importance of the use of flexible mechanisms, such as emissions trading and joint implementation and the clean development mechanism.

1.1 TOWARDS A GLOBAL POST-2012 ARCHITECTURE?

From a negotiation point of view, the principal challenge in devising a truly global architecture is to provide sufficient incentives for parties to participate in a global agreement. Incentives have been extensively researched by the economic literature. The other side of the coin is compliance, the complementary element of regime building. A global architecture would only work if participants can be reasonably certain that all parties comply. This raises global governance issues, a focal point of the political science literature.

Both the UNFCCC and the Kyoto Protocol have addressed 'incentives' for participation in several ways; differentiation between emitters according to historical emissions, state of development and capacity have been enshrined into the present architecture and will continue to remain a central pillar. Other elements include government transfers via International Emissions Trading or specific funds such as the Adaptation, the Special Climate Change, the Least Developing Countries Fund or the project mechanisms of the Clean Development Mechanism (CDM) and Joint Implementation (JI) that focus on 'clean investment'.

Beyond that, there have been numerous – alternative or complementary – proposals to enhance participation, incorporating many of the ideas from the existing theoretical and empirical literature. Consideration has been given, for example, to allowing different time-frames for entering into commitments (a graduation concept), to a country's or region's response to impacts (adaptation), to implementation (how to ensure compliance) and to the framework for negotiation (institutions). Perhaps the biggest and most prominent part of the literature, certainly in economics, has focused on the nature of the commitments (that is, type of targets), such as absolute caps, efficiency targets, technology development or objectives, coordinated carbon taxes, coordinated sector-specific domestic policies or a mixture thereof. For an overview of the numerous proposals put forward, see Box 1.1.

BOX 1.1 DIFFERENT APPROACHES FOR POST-2012

- An international agreement with absolute – Kyoto-style – targets, but with modifications such as a safety valve, that is, a maximum price on allowances (Jacoby and Ellerman, 2002; Kopp et al., 1999; Hourcade and Ghersi, 2001; McKibbin and Wilcoxen, 2002).
- Energy or carbon-intensity targets to improve energy efficiency. Ultimate targets can be an equal per capita emissions target (Meyer, 2003; Müller et al., 2001).
- Linkages, that is, linking participation to R&D cooperation or financial transfers (Buchner et al., 2005; Buchner and Carraro, 2003; Carraro and Galeotti, 2003).
- Environmental conditionality that links emissions trading to environmental 'progress', for example, the Green Investment Scheme, trade and bank approaches (Tangen et al., 2001; Blyth, 2003; Viguier, 2003).
- Sector-specific targets, that is, a coordinated approach for domestic policies (for example, IEA, 2002: 82).
- Coordinated global carbon taxes (Cooper, 2001).
- Technology development and international cooperation on R&D activities, often referred to as 'technology protocol' (Humphreys, 2001; Barrett, 2003; Edmonds, 2003).
- A combination of different instruments, such as a combination of the intensity targets, sector-specific domestic measures and technology development in the so-called 'triptych approach' (Phylipsen et al., 1998; Den Elzen, 2002).
- Orchestra of treaties focusing on different coexisting commitments under different legal frameworks (Sugiyama et al., 2003).

For a comprehensive survey of post-2012 approaches, see also Bodansky (2004).

Source: Egenhofer et al. (2004).

When assessing different sets of commitments against criteria – such as environmental outcome, economic efficiency, cost-effectiveness, distributional impacts, flexibility and simplicity – and incentives to participate and comply, there is no single framework that would meet all the evaluation

criteria (see for example Aldy et al., 2003; Bodansky, 2004; Torvanger et al., 2004; Kameyama, 2004). This is the case with the Kyoto Protocol as well. This state of play has gradually increased interest in bottom-up approaches. Best-known bottom-up approaches include coordinated sector-specific domestic policies, combination of instruments, graduation concepts and orchestras of treaties (for example Phylipsen et al.,1998; Den Elzen, 2002; Sugiyama et al., 2003). However, the literature on the international climate architecture continues to be dominated by top-down approaches, that is, identifying the 'magic concept' that meets equity, efficiency, flexibility, simplicity and other relevant criteria against which effectiveness of climate regimes are usually judged.

1.2 SHORTCOMINGS OF TOP-DOWN APPROACHES

The top-down approach (that is, 'what needs to be done') of the Kyoto Protocol of party-based or national allocation of absolute emissions ceilings exhibits two main shortcomings, despite its merits of relative simplicity as a negotiation tool and of sensitivity to environmental integrity. The first shortcoming relates to participation and the difficulties in agreeing on a global burden-sharing (that is, a set of national targets). Large participation in a climate agreement with an appropriate level of ambition is necessary to stabilize GHG emissions, that is to meet the long-term objectives identified in the United Nations Framework Convention on Climate Change (UNFCCC). The second shortcoming relates to compliance. Targets which are negotiated and agreed at the international level, but are perceived as inequitable, may not be ratified by domestic institutions, as we have learned in the aftermath of the Kyoto Protocol through the US defection. To overcome the risk of perception of inequitable contributions, the Kyoto Protocol foresaw relatively short-term targets, subject to periodic revision. However, short-term targets can only cause behaviour changes, yet are unable to initiate structural changes. Indeed one of the criticisms of the Kyoto Protocol, notably but not only by the US, has been short-termism, meaning that time-frames are out of step with needs of the business community in which investment decisions are made on a mid-term to long-term basis (Aldy et al., 2003; Reinstein, 2004; Lempert et al., 2002; PEW Center, 2003; Egenhofer et al., 2004 and IEA, 2002 for an overview).

Given the current difficulties to overcome the certainty and predictability issue as a result of a lack of agreement on how to move forward on a global scale, there is an increasing interest in how to invigorate major emitters' domestic policies and their coordination at a 'sub-global' scale,

usually referred to as 'bottom-up' approaches ('what can be done') to the formation of a global regime. Such bottom-up approaches include national strategies, regional or, more generally, sub-global arrangements, and sectoral cooperation. They have the potential to address – to some extent – the issues associated with short-term targets and sensitivities related to competitiveness, and thereby are meant to address incentives and compliance issues.

1.3 EVIDENCE OF BOTTOM-UP APPROACHES AND REGIONALIZATION

Even with the Kyoto Protocol in force and discussions of a second commitment period launched, the regime designed to deal with global climate change remains distinctly 'non-global' and disconnected, characterized by the coexistence of different approaches rather than a coordinated global effort to tackle climate change. The original UNFCCC always foresaw action according to 'common but differentiated responsibilities', but the Kyoto Protocol assumed that industrialized countries would share roughly comparable goals including a legally binding target. The US withdrawal from the entire Kyoto process means that the climate change landscape is further disintegrated into different groupings. They include industrialized countries that have ratified the Protocol ('Kyoto-land'), those that have not (for example the US, Australia) and developing countries, which again consist of various sub-groups. Despite an apparent willingness of the Kyoto Protocol countries to continue discussions on the future shape of a climate regime after the end of its mandate in 2012, there is no sign in the international negotiations that fragmentation will be reduced (PEW Center, 2005, 2006; Wittneben et al., 2006; Müller, 2006). There is little likelihood that the US – under any government whatsoever – would (re)join the Kyoto Protocol, at least in the short to medium term. There remains vast uncertainty on what kind of commitments developing countries would be willing to take on. At the same time, there are numerous cross-cutting agreements, mainly but not only on technology. The most prominent is the Asia-Pacific Partnership comprising both Kyoto Protocol (Annex I, Non-Annex I) countries and those that have decided to stay outside the Kyoto Protocol framework. Similarly, the EU and other Kyoto Protocol countries are continuously negotiating bilateral agreements and many countries are experimenting with domestic policies. A recent consultation on the climate regime beyond 2012 with China, India, Indonesia, Japan, the Republic of Korea and Viet Nam has clearly identified the importance of considering climate concerns in the development context,

while equally denouncing the lack of transparency of previous negotiations (IGES, 2005).

While, legally speaking, the framework is the (global) UN system, in reality it is the delicate balance between diverging interests that has dictated the discussions. This is even more so after the defection of the US. In fact the negotiations for the Kyoto Protocol have been characterized by bargaining between the EU, the US, and Japan, Russia and rest of the then so-called Umbrella Group (see Den Elzen and de Moor, 2002; Egenhofer and Cornelis, 2001; Grubb and Yamin, 2001).

This has raised two research questions that this book addresses. The first is to what extent bottom-up approaches could provide additional incentives for countries to join an international climate regime. The second is the question of institutional underpinning of such arrangements and how they relate to the broader UNFCCC framework. The objective of this book is to test the thesis that a series of regional agreements is more likely to achieve a stable and profitable international agreement in the medium term than a global agreement attempted from the outset would. We will then ask how these agreements could be achieved. The approach we take is to identify the potentially 'winning policies' (that is, policies and their institutional underpinning) that could lead to informal deals or what we call 'sub-global arrangements'.

We have chosen the term 'sub-global agreements' in such a way that agreements do not necessarily need to be on a regional level – although in reality they might. Informally within the Kyoto Protocol there have always been groupings of countries and regions: the EU, Umbrella countries, economies in transition (EITs), Central and Eastern Europe, OPEC and so on. One could therefore ask whether within smaller settings, for example in a 'sub-global' setting such as EU–Russia, EU–Russia–Japan or even Japan–China–Other Asia, an equilibrium may be easier found. What seems to matter most, for example for the EU and Japan, is that the US and some other major competitors are subject to carbon-constraining policies to reduce potentially negative effects on competitiveness. Such carbon-constraining policies do not necessarily have to be implemented at the global level. If implemented at the sub-global level, agreements might be reachable more easily.

1.4 THEORETICAL BACKGROUND

When examining the possible contribution of bottom-up approaches in achieving a global agreement, this book will at the same time rely on international relations theory, notably regime theory, and existing economic

literature on climate change, notably that based on game theory, both of which address bottom-up versus top-down approaches.

Regime theory, the dominant strand in political science and international relations theory on international cooperation, has traditionally centred on the importance of both self-interested behaviour and institutional factors in determining outcomes (Williams, 1998), thereby incorporating both bottom-up and top-down studies. Depending on the school of thought, different emphasis has been attached to power (for example by neo-realists), interests (neo-liberals) or ideas and discourses (by constructionists).[2] Initially, the approach was 'regime-centric', emphasizing institutional performance rather than environmental outcomes (Kütting, 2000), hence placing a strong focus on governance and institution building. Young pioneered the treatment of climate change in regime theory by developing a model of institutional bargaining (Young, 1989, 1993, 2002a) with a stress on environmental outcomes, that is, research that has considered the environmental problem necessitating the agreement.

A different strand of theory highlights the interplay of different international regimes (Stokke, 2001; Ghering and Oberthür, 2000; Young, 2002c). Horizontal interplay involves regimes on the same level, for instance between global regimes or between sub-global regimes such as the interface of the World Trade Organization (WTO) and the Kyoto Protocol (see Brewer, 2003). Vertical interplay involves regimes on different levels, for instance between international agreements and regional agreements, or between international agreements and national legislation (Young, 2000a and Young, 2000b in Stokke, 2001). Chapter 4 of this book covers both types of interplay.

International regime theory has been characterized by a debate on the relative merits of bottom-up and top-down approaches and studies (Young, 2002b). This tension was most profoundly apparent in the policy controversy over global environmental governance (see Gemmill et al., 2002; Brack and Hyvarinen, 2002; Dodds et al., 2002; Esty and Ivanova, 2002a; Brack and Hyvarinen, 2000). Proponents of centralization called for clustering of multilateral environmental agreements by organizational bodies, functions, issues and regions, together with the establishment of a single agency such as a World Environment Organization or a Global Environmental Mechanism (GEM) (Esty and Ivanova, 2002b; von Moltke, 2002) to provide for adequate information, a policy space for negotiation and bargaining, and capacity building. The opponents of centralization support the streamlining of the current system (Najam, 2002; Kimball, 2002; Whalley and Zissimos, 2002). Dodds et al. (2002) argue that innovation proceeds more rapidly with an (optimal) degree of fragmentation as a result of systems competition. An outcome of this controversy was the

study by Miles et al. (2002) which gathered over a decade of experiences in testing regime theory through case-studies on international environmental regimes.

The contribution of economics has been in emphasizing the importance of incentives to join a global climate change regime. International environmental agreements can – in the absence of a fully functioning international governance structure – only be achieved on a voluntary basis. Because climate change protection is a global public good – no country can be prevented from enjoying climate protection irrespective of participation – such agreements provide very high incentives to free-ride (for example Barrett, 1994; Carraro and Siniscalco, 1993, 1998). Recent economic literature on international climate change agreements has concentrated on incentives for participating countries to sign up to such agreements. This can be done by using either 'sticks' (that is, disincentives for non-participation) such as trade sanctions (for example Chen, 1997; Brewer, 2003), or 'carrots' (that is, incentives) such as different target allocation mechanisms, transfers, emissions trading to lessen the costs for emissions reductions, issue linkage, and better access to research and technological development (for example Carraro and Galeotti, 2003).

The economic literature on international environmental agreements largely relies on recent developments of game theory. Using this tool, it is possible to analyse a country's incentive to free-ride on an environmental agreement and therefore the stability of the agreement itself (see Carraro and Marchiori, 2003). One of the main results of research on participation incentives can be phrased as follows. If negotiating countries are free to decide not only whether or not to sign a treaty, but also which treaty (that is, which coalition to join), there is generally more than one coalition at the equilibrium. For example, in the case of trade negotiations, there may be several trade blocs. In the case of environmental negotiations, there may be several regional or sub-global climate agreements. This conclusion can be found, for example, in Bloch (1995, 1996), Ray and Vohra (1997, 1999), Yi (1997, 2003) and Yi and Shin (1995).

Therefore, this game-theoretical literature, albeit focused on very simple and abstract models, supports a bottom-up approach to climate policy agreements by stressing that endogenous forces may lead to cooperation, but that this cooperation is likely to take place at the sub-global or regional level.

Moreover, beyond the scope of negotiations, the conceptual framework follows the recent strand of regime theory and global governance theory that governments have lost control over their territory, highlighting 'the question of whether the modern system of states may be yielding in some instances to post-modern forms of configuring political space'

(Ruggie, 1993),[3] provoking a debate over the declining role of states in global governance (Falkner, 2003; Scholte, 2002; Krasner, 2001).

The debate on the declining role of the state has highlighted the interface of governments and market developments. This is where economics and international relations interact strongest. On the one hand it would be reasonable to suggest that the ongoing globalization process is largely driven by markets, that is, economic rents. On the other hand, proposed emissions trading markets are carefully designed by governments for strategic reasons in an attempt to fulfil their commitments to their greenhouse gases (GHG) reduction target.

The conceptual framework allows us to analyse the interaction between a group of countries' progress in fulfilling their commitments to the assigned targets on the one hand, and the development of emissions trading markets, or 'climate change areas', on the other hand. This is where the link with the economic climate change literature is.

1.5 ABOUT THIS BOOK

This book analyses the possibility to control climate change through a set of regional or sub-global climate agreements, rather than through a global treaty. The main purpose of this book is not to trace in detail the process of negotiation and implementation of international regimes. On the contrary, the book will evaluate the thesis that a series of regional agreements is more likely to achieve climate change control than a global agreement attempted from the outset would, and it will explore how these agreements can be achieved.

The book[4] is structured into this introduction plus four principal chapters and a concluding chapter which summarizes the policy implications of our analysis. Chapter 2 provides a bottom-up game-theoretic perspective on the economic consequences of some regional or sub-global agreements. Rather than focusing on issue linkage, transfers or burden sharing as tools to enhance the incentives to participate in a climate agreement, Chapter 2 explores the implications of a bottom-up approach to climate control. Chapter 3 supplies a political science perspective by using the example of EU regionalization. As a political science analysis, the focus is on institution building and governance and notably their implications for global agreements. Chapter 4 analyses recent developments in the world trade system as regards the interaction between multilateral and unilateral trade agreements, and draws tentative conclusions for climate change. Chapter 5 investigates the effects on R&D cooperation, which the literature has singled out as a critical pillar upon which any global or regional agreement

will be based. Finally, the concluding chapter discusses the lessons learnt from our analysis and provides a few policy recommendations that could help in designing future climate negotiations.

NOTES

1. A free-rider enjoys the benefits of a policy without paying for it.
2. For an analysis see for example Young (2002b).
3. For a short overview of different notions of statehoods and the application to EU–Russia relations, see Emerson (2001).
4. The editors of this book are grateful to ESRI for continuous support and advice in the preparation of this book. In particular, Mr Kato and Dr Omori provided useful comments on a first draft of this book. We are also grateful to Yoshika Yamamoto for editorial assistance and to our staff at FEEM and CEPS for many useful inputs. Comments from participants at the ESRI Meeting of Collaboration Projects held in Tokyo in March 2005 are gratefully acknowledged.

REFERENCES

Aldy, J.E., S. Barrett and R.N. Stavins (2003), 'Thirteen plus one: a comparison of global climate policy architectures', *Climate Policy*, **3**, 373–97.

Barrett, S. (1994), 'Self-enforcing international environmental agreements', *Oxford Economic Papers*, **46**, 878–94.

Barrett, S. (2003), *Environment and Statecraft: The Strategy of Environmental Treaty-Making*, Oxford: Oxford University Press.

Bloch, F. (1995), 'Endogenous structures of associations in oligopolies', *RAND Journal of Economics*, **26**, 537–56.

Bloch, F. (1996), 'Sequential formation of coalitions in games with externalities and fixed payoff division', *Games and Economic Behavior*, **14**, 90–123.

Blyth, W. (2003), 'Green Investment Schemes: options and issues', International Energy Agency, Paris, IEA/OECD, COM/ENV/EPOC/IEA/SLT(2003)9.

Bodansky, D. (2004), 'International climate efforts beyond 2012: a survey of approaches', Arlington, VA, Pew Center on Global Climate Change.

Brack, D. and J. Hyvarinen (eds) (2002), *Global Environmental Institutions: Perspectives on Reform*, London: Royal Institute of International Affairs.

Brewer, T. (2003), 'International trade, the WTO and international climate arrangements', final report of a study prepared for the Environmental Studies Group, ESRI, Cabinet Office, Government of Japan, for International Forum for Environmental Issues, Tokyo, 27 February – 1 March 2003.

Buchner, B. and C. Carraro (2003), 'Can technological change, R&D co-operation and other technology-based policy strategies increase countries' participation in a climate regime?', paper presented at IFRI-RFF Conference on Post-Kyoto Strategies in Paris, 19 March.

Buchner, B., C. Carraro, I. Cersosimo and C. Marchiori (2005), 'Back to Kyoto? US participation and the linkages between R&D and climate cooperation', in A. Haurie and L. Viguier (eds), *The Coupling of Climate and Economic Dynamics*, Dordrecht, The Netherlands: Kluwer Academic Publishers.

Carraro, C. and M. Galeotti (2003), 'The future evolution of the Kyoto Protocol: costs, benefits and incentives to ratification and new international regimes', in C. Carraro and C. Egenhofer (eds), *Firms, Governments and Climate Policy: Incentive-Based Policies for Long-Term Climate Change*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.
Carraro, C. and C. Marchiori (2003), 'Stable coalitions', in C. Carraro (ed.), *The Endogenous Formation of Economic Coalitions*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.
Carraro, C. and D. Siniscalco (1993), 'Strategies for the international protection of the environment', *Journal of Public Economics*, **52**, 309–28.
Carraro, C. and D. Siniscalco (1998), 'International environmental agreements: incentives and political economy', *European Economic Review*, **42**, 561–72.
Chen, Z. (1997), 'Negotiating an agreement on global warming: a theoretical analysis', *Journal of Environmental Economics and Management*, **32** (2), 170–88.
Cooper, R. (2001), 'The Kyoto Protocol: a flawed concept', *Environmental Law Reporter*, **31**, 11484–92.
Den Elzen, M.G.J. (2002), 'Exploring post-Kyoto climate regimes for differentiation of commitments to stabilise greenhouse gas concentrations', RIVM report, 728001020.
Den Elzen, M.G.J. and A.P.G. de Moor (2002), 'Evaluating the Bonn–Marrakesh agreement', *Climate Policy*, **2** (2), 111–17.
Dodds, S.E.H., W.B. Chambers and N. Kanie (2002), 'International environmental governance: the question of reform: key issues and proposals (preliminary report)', UNU/IAS.
Edmonds, J. (2003), 'Toward the development of a Global Energy Technology Strategy to address climate change', paper prepared for a strategic roundtable on Global Energy Scenarios of the World Gas Conference, 2 June.
Egenhofer, C. and Cornelis, J. (2001), 'Reinventing the climate negotiations: an analysis of COP6', CEPS Policy Brief No. 1. Brussels: Centre for European Policy Studies (CEPS).
Egenhofer, C., N. Fujiwara, D. Kernohan, T. Brewer and L. Van Schaik (2004), 'The future of the international climate change regime: the contribution of "regional approaches" towards an international agreement', study by the Centre for European Policy Studies prepared for the Economic and Social Research Institute, Cabinet Office, Government of Japan.
Emerson, M. (2001), *The Elephant and the Bear*, CEPS Paperback Books.
Esty, D.C. and M.H. Ivanova (eds) (2002a), *Global Environmental Governance: Options and Opportunities*, New Haven, CT: Yale School of Forestry and Environmental Studies.
Esty, D.C. and M.H. Ivanova (2002b), 'Revitalising global environmental governance: a new function-driven approach', in D. Brack and J. Hyvarinen (eds), *Global Environmental Institutions: Perspectives on Reform*, London: Royal Institute of International Affairs.
Falkner, R. (2003), 'Private environmental governance and international relations: exploring the links', *Global Environmental Politics*, **3** (2), 72–87.
Gemmill, B., M. Ivanova and C.Y. Ling (2002), 'Designing a new architecture for global environmental governance', World Summit on Sustainable Development: Opinion.
Ghering, T. and S. Oberthür (2000), 'Exploring regime interaction: a framework of analysis', part of the proceedings of the Final Conference within the

EU-financed Concerted Action Programme on the Effectiveness of International Environmental Agreements and EU legislation, in Barcelona, 9–11 June.
Grubb, M. and F. Yamin (2001), 'Climate collapse at The Hague: what happened, why and where do we go from here?' *International Affairs*, **77**, 2 (April), 297–312.
Hourcade, J.C. and F. Ghersi (2001), 'The economics of a lost deal: Kyoto–The Hague–Marrakesh', *Energy Journal*, **23**, 3.
Humphreys, K. (2001), 'The nation's energy future: The role of renewable energy and energy efficiency', testimony to the Committee on Science of the US House of Representatives, 28 February.
IEA (2002), *Beyond Kyoto: Energy Dynamics and Climate Stabilisation*, Paris: International Energy Agency.
IGES (2005), 'Asian Perspectives on Climate Regime Beyond 2012: Concerns, Interests and Priorities', Institute for Global Environmental Studies (IGES), Hayama, Japan.
Jacoby, H.D. and A.D. Ellerman (2002), 'The safety valve and climate policy', MIT Joint Program on the Science and Policy of Global Change, Report **83**, Cambridge, MA.
Kameyama, Y. (2004), 'The future climate regime: a regional comparison of proposals', *International Environmental Agreements: Politics, Law and Economics*, **4**, 307–26.
Kimball, L.A. (2002), 'The debate over a World/Global Environment Organisation', in D. Brack and J. Hyvarinen (eds), *Global Environmental Institutions: Perspectives on Reform*, London: Royal Institute of International Affairs.
Kopp, R., R. Morgenstern, W. Pizer and M. Toman (1999), 'A proposal for credible early action in US climate change policy', Resources for the Future, Washington, DC.
Krasner, S.D. (2001), 'Sovereignty (history of the concept)', *Foreign Policy*, January.
Kütting, G. (2000), 'Distinguishing between institutional and environmental effectiveness in international environmental agreements: the case of the Mediterranean Action Plan', *International Journal of Peace Studies*, **5** (1), 15–33.
Lempert, R.J., S.W. Popper, S.A. Resetar and S.L. Hart (2002), 'Capital Cycles and the Timing of Climate Change Policy', study by the PEW Center on Global Climate Change, Arlington, VA, available at www.pewclimate.org.
McKibbin, W.J. and P.J. Wilcoxen (2002), 'The role of economics in climate change policy', *Journal of Economics Perspectives*, **16** (2), 107–29.
Meyer, A. (2003), 'Trading up to climate security', *Energy and Environmental Management*, May/June, 16–17.
Miles, E.L., A. Underdal, S. Andresen, J. Wettestad, J.B. Skjærseth and E.M. Carlin (2002), *Environmental Regime Effectiveness: Confronting Theory with Evidence*, Cambridge, MA: MIT Press.
Müller, B. (2006), 'Montreal 2005: what happened, and what it means', Oxford Institute for Energy Studies, EV 35, February.
Müller, B., A. Michaelowa and C. Vrolijk (2001), 'Rejecting Kyoto: a study of proposed alternatives to the Kyoto Protocol', Climate Strategies, www.climate-strategies.org.
Najam, A. (2002), 'The case against GEO, WEO, or Whatever-else-EO', in D. Brack and J. Hyvarinen (eds), *Global Environmental Institutions: Perspectives on Reform*, London: Royal Institute of International Affairs.
PEW Center (2003), 'Beyond Kyoto: Advancing the International Effort Against Climate Change', prepared for the Pew Center on Global Climate Change, December.

PEW Center (2005), 'COP 11 and COP/MOP 1 Montreal, Eleventh Session of the Conference of the Parties to the UN Framework Convention on Climate Change (COP 11) and First Meeting of the Parties to the Kyoto Protocol (COP/MOP 1)', Montreal, Canada, 28 November–10 December; summary at www.pewclimate.org/what_s_being_done/in_the_world/cop 11/index.cfm.

PEW Center (2006), 'Twelfth Session of the Conference of the Parties to the UN Framework Convention on Climate Change and Second Meeting of the Parties to the Kyoto Protocol', Nairobi, Kenya, 6–17 November, summary at www.pewclimate.org/what_s_being_done/in_the_world/cop 12/summary.cfm#bus.

Phylipsen, G.J.M., H. Groenenberg and K. Blok (1998), 'The EU burden sharing after Kyoto: renewed triptych calculations', May.

Ray, D. and R. Vohra (1997), 'Equilibrium binding agreements', *Journal of Economic Theory*, **73**, 30–78.

Ray, D. and R. Vohra (1999), 'A theory of endogenous coalition structures', *Games and Economic Behavior*, **26**, 286–336.

Reinstein, R.A. (2004), 'A possible way forward on climate change', *Mitigation and Adaptation Strategies for Global Change*, **9**, 295–309.

Ruggie, J.G. (1993), 'Territoriality and beyond: problematizing modernity in international relations', *International Organization*, **47** (1), 139–74.

Scholte, J.A. (2002), 'What is globalisation? The definitional issue – again', CSGR Working Paper, 109/02.

Stokke, O.S. (2001), 'The interplay of international regimes: putting effectiveness theory to work', FNI Report 14.

Sugiyama, T., K. Tangen, A. Michaelowa, J. Pan and H. Hasselknippe (2003), 'Scenarios for the Global Climate Regime', Briefing Paper, www.fni.no/post2012/briefing-paper.pdf.

Tangen, K., A. Korppoo, V. Berdin, T. Sugiyama, C. Egenhofer, J. Drexhage, O. Pluzhnikov, M. Grubb, T. Legge, A. Moe, J. Stern and K. Yamaguchi (2001), 'A Russian Green Investment Scheme – Securing environmental benefits from international emissions trading', Climate Strategies report, www.climate-strategies.org.

Torvanger, A., M. Twena and J. Vevatne (2004), 'Climate policy beyond 2012: a survey of long-term targets and future frameworks', CICERO report 2004: 02, Center for International Climate and Environmental Research, Oslo, www.cicero.uio.no.

Viguier, L. (2003), 'Defining meaningful participation of developing countries in climate change mitigation', paper prepared for IFRI-RFF Conference on Post-Kyoto Strategies in Paris, 19 March.

Von Moltke, K. (2002), 'Clustering international environmental regimes', in D. Brack and J. Hyvarinen (eds), *Global Environmental Institutions: Perspectives on Reform*, London: Royal Institute of International Affairs.

Whalley, J. and B. Zissimos (2002), 'Making environmental deals: the economic case for a World Environmental Organization', in D.C. Esty and M.H. Ivanova (eds), *Global Environmental Governance: Options and Opportunities*, New Haven, CT: Yale School of Forestry and Environmental Studies.

Williams, M. (1998), 'Aid, sustainable development and the environmental crisis', *International Journal of Peace Studies*, **3**, 2.

Wittneben, B., W. Sterk, H. Ott and B. Brouns (2006), 'In from the cold: the climate conference in Montreal breathes new life into the Kyoto Protocol', Wuppertal Institute for Climate, Environment and Energy.

Yi, S.-S. (1997), 'Stable coalition structures with externalities', *Games and Economic Behaviour*, **20**, 201–23.
Yi, S.-S. (2003), 'Endogenous formation of economic coalitions: a survey of the partition function approach', in C. Carraro (ed.), *Endogenous Formation of Economic Coalitions*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.
Yi, S.-S. and H. Shin (1995), 'Endogenous formation of coalitions: oligopoly', mimeo, Department of Economics, Dartmouth College.
Young, O. (1989), 'The politics of international regime formation: managing natural resources and the environment', *International Organisation*, **43** (3), 349–75.
Young, O. (1993), 'Negotiating an international climate regime: the institutional bargaining for environmental governance', in N. Choucri et al. (eds), *Global Accords* Cambridge, MA: MIT Press.
Young, O. (2002a), 'Matching institutions and ecosystems: the problem of fit', paper for the seminar series Economy of the Environment and Sustainable Development, co-organised by IDDRI and MEDD, Paris, 25 June.
Young, O. (2002b), 'Why is there no unified theory of environmental governance?' essay prepared for delivery at the 9th Biennial Conference of the International Association for the Study of Common Property, June.
Young, O. (2002c), *The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale*, Cambridge, MA: MIT Press.

2. Regional and sub-global climate blocs: a cost–benefit analysis of bottom-up climate regimes[1]

Barbara Buchner and Carlo Carraro

Climate negotiations are a complex dynamic process. Climate change control, being a global public good, can hardly be attained on a voluntary basis. At the same time, there is no supranational authority that can impose an effective international climate policy. Therefore, an international cooperative and voluntary agreement to curb global greenhouse gas (GHG) emissions seems to be the only way to combat climate change. However, because of free-riding incentives and strong economic and environmental asymmetries, it is unlikely that an international climate agreement will be signed by a large number of countries (Carraro and Siniscalco, 1993; Botteon and Carraro, 1997), unless its goals are not significantly different from those of a non-cooperative, business-as-usual, domestic policy (Barrett, 1994).

Nonetheless, since the signing of the Kyoto Protocol in 1997, the diplomacy of climate policy has made considerable progress. International climate policy has recently enjoyed its first noteworthy success. The Kyoto Protocol came into force on 16 February 2005 and countries worldwide have already started discussions on a possible, better designed, post-2012 climate agreement.

However, the US defection from the Kyoto Protocol and the lack of explicit abatement targets for the main developing countries – China and India above all – have largely reduced the environmental effectiveness of the Kyoto Protocol, which remains far from achieving the objective of stabilizing GHG concentrations at about 500–550 ppmv. Therefore, several policy proposals have emerged that could be adopted after 2012 and that could enhance the incentives to participate in a climate agreement (see Aldy et al., 2003a; Aldy et al., 2003b; Bodansky, 2004; Baumert et al., 2002; CNRS/LEPII-EPE et al., 2003; OECD/IEA, 2002). Some of these proposals are based on targets and timetables, others on the adoption of global economic instruments, others on technological development and cooperation,

and others are a mix of different approaches (see Barrett, 2001; Nordhaus, 2001; Kopp et al., 1999; Pizer, 1999; McKibbin and Wilcoxen, 1997).

Among the many existing proposals, there is one that has both a theoretical and an empirical appeal. It can be found in Carraro (1998, 1999) where a game-theory argument was the main driver, and more recently in other articles (see Egenhofer and Legge, 2001; Egenhofer et al., 2001; Stewart and Wiener, 2003; Reinstein, 2004; Victor 2006) where more practical considerations are used to support a similar proposal. The basic idea is to adopt a bottom-up, country-driven approach to defining national commitments. Instead of top-down, international negotiations on national emission targets, each country would determine its contribution to a cooperative effort to curb GHGs and choose the partners with whom it intends to cooperate. In a process analogous to trade negotiations, each country would put its offer of commitments on the negotiating table and invite proposals from other countries for similar commitments.

This basic idea may lead to a quite fragmented climate regime and to the formation of climate blocs (regional coalitions, for example) in much the same way as is now emerging in trade negotiations. This should not be surprising. In substance, even though not in form, the Kyoto Protocol already reflects agreements among several different coalitions. It incorporates special provisions for several different groups of countries. The Non-Annex B countries have no commitments and can benefit from emissions reduction investments through the Clean Development Mechanism (CDM). The most vulnerable Non-Annex B countries can also receive financial assistance for adaptation from the levy imposed on the CDM (and possibly on the other mechanisms). The European Union has the ability under Article 4 to redistribute the emissions reduction burden. Australia has negotiated a special provision on land use emissions in Article 3.7.[2]

In addition, the lesson that can be derived from trade negotiations consistently tells us that progress on trade liberalization can be achieved mostly through regional agreements, at least in the coming years.[3] In international trade, the 'resurgence' of regionalism has thus become a crucial subject, underscored by the formation of competing customs unions and the debate about free trade areas. Substantial attention has been focused on the efficiency and implications of these regional or sub-global cooperations (see Baldwin, 1993, 1997; Casella, 1995; Bloch and Ferrer, 1999; Bond and Syropoulos, 1996; Krugman, 1991; Yi, 1996a, 1996b).

In particular, several authors have pointed out that regional trade agreements (RTAs) may seem to be contradictory, but they can often actually support the World Trade Organization's multilateral trading system (see Sampson and Woolcock, 2003). Regional agreements have allowed groups of countries to negotiate rules and commitments that go beyond what was

previously possible multilaterally. In turn, some of these rules have paved the way for agreements within the WTO. Services, intellectual property, environmental standards, investment and competition policies are all issues that were raised in regional negotiations and later developed into agreements or topics of discussion in the World Trade Organization (WTO).[4] For these reasons, on 6 February 1996, the WTO General Council created the Regional Trade Agreements Committee. Its purpose is to examine regional groups and to assess whether they are consistent with WTO rules. The committee is also examining how regional arrangements might affect the multilateral trading system, and what the relationship between regional and multilateral arrangements might be.

Can something similar take place in climate negotiations? Can countries find more incentives to participate in regional or sub-global climate agreements than in a global agreement? The answer from game theory is quite straightforward. One of the most important conclusions achieved in the non-cooperative theory of coalition formation (see Carraro and Marchiori, 2003 for a survey) is as follows. If countries are free to decide not only whether or not to sign a treaty but also which treaty (that is, which coalition to join), there is generally more than one coalition at the equilibrium. For example, in the case of trade negotiations, there may be several trade blocs. In the case of environmental negotiations, there may be several regional or sub-global climate agreements.

This conclusion can be found for example in Bloch (1995, 1996), Ray and Vohra (1997, 1999), Yi (1997, 2003) and Yi and Shin (1995). The models used in these studies analyse the formation of multiple coalitions by adopting different notions of stability. Bloch (1995, 1996) examines an infinite-horizon 'coalition unanimity' game, in which a coalition forms if and only if all potential members agree to form the coalition. Ray and Vohra (1997) assume the 'equilibrium binding agreement' rule, under which coalitions are allowed to break up into smaller sub-coalitions only. Yi and Shin (1995) investigate the 'open membership' game, in which non-members can join an existing coalition even without the consensus of the existing members. Different membership rules lead to different predictions about stable coalition structures (see Carraro and Marchiori, 2003). For example, the 'open membership' rule is unlikely to support the grand coalition as an equilibrium outcome. The equilibrium coalition structure is generally very fragmented. By contrast, the 'coalition unanimity' rule and the 'equilibrium binding agreements' rule support more concentrated coalition structures at the equilibrium, but quite often not the grand coalition (see Finus and Rundshagen, 2003).

The above results can be used to argue that the Kyoto Protocol is unlikely to be signed by all the relevant players and that the emergence of alternative

climate blocs is likely (see Carraro, 1998, 1999; Bloch, 2003; Finus and Rundshagen, 2003; Yi, 2003). All these papers use a game-theory approach. However, some indications that regional or sub-global climate blocs could be the appropriate way to address the difficulties emerging in climate negotiations can also be found in the political science literature (see, for example, Egenhofer and Legge, 2001; Egenhofer et al., 2001; Stewart and Wiener, 2003; Reinstein, 2004; Victor, 2006).

Game theory is still unable to identify the characteristics of the coalitions which would form at the equilibrium, because in theoretical models countries are usually assumed to be symmetric. By contrast, in actual climate negotiations, economic and environmental asymmetries play a very important role in defining a country's participation incentives. Therefore, this chapter, rather than analysing all possible coalition structures in order to single out the stable ones, highlights the costs and benefits of some relevant coalition structures (those that seem most likely to emerge on the basis of the recent evolution of climate negotiations) and analyses their main economic and policy (asymmetric) implications.

The next section will provide an empirical assessment of the economic implications of different climate blocs, that is, fragmented coalition structures in which no single agreement is signed. We will analyse impacts on the domestic welfare of different countries and global environmental impacts as well. The subsequent section will draw some policy conclusions, whereas the concluding section summarizes our analysis of a bottom-up approach to climate policy.

2.1 REGIONAL AND SUB-GLOBAL CLIMATE BLOCS: A COST–BENEFIT ANALYSIS

The analysis of the possible economic consequences of some bottom-up climate regimes has been carried out by using a modified version of Nordhaus's RICE model (see Nordhaus and Yang, 1996) in which endogenous and induced technical change are modelled. In our version of the model, called FEEM-RICE (see Buonanno et al., 2002), technical change performs a twofold role: on the one hand, via increasing returns to scale, it yields endogenous growth; on the other hand, by affecting the emissions–output ratio, it accounts for the adoption of cleaner and energy-saving technologies. A detailed description of the role of technical change in FEEM-RICE is contained in the Appendix to this chapter.

In the model, six countries/regions (the US, the EU, Japan – JPN, the former Soviet Union – FSU, China – CHN, and the Rest of the World –

ROW) optimally set the intertemporal values of four strategic variables: investments, R&D expenditure, abatement effort and net demand for emissions permits.[5] When no coalition forms, each country/region maximizes its own individual welfare, given the other countries' strategy. Countries which belong to the same coalition maximize their joint welfare. Given the interdependency of countries' decisions, the equilibrium value of the control variables is the solution for a dynamic open-loop Nash game. We apply thus an extension of the PANE – partial agreement Nash equilibrium concept – introduced by Eyckmans and Tulkens (2002).

In addition to the model structure, two assumptions qualify our results.[6] First, all countries/regions which adhere to the Kyoto/Bonn agreement are assumed to meet their Kyoto target from 2010 onward.[7] We therefore adopt the so-called 'Kyoto forever' hypothesis (Manne and Richels, 1999). Our reference to the Kyoto/Bonn agreement is partly imprecise since, for the sake of brevity, we will at times call the 'Kyoto Protocol' or 'Kyoto/Bonn agreement' a 'Kyoto forever' scenario.

Second, cooperating countries are assumed to adopt cost-effective environmental policies. In particular, cost-effective market mechanisms (for example, emissions trading) are chosen over 'command-and-control' measures in order to guarantee an efficient implementation of the environmental targets adopted within the coalition. Notice that Annex B countries that belong to a coalition and thus engage in emissions trading face their Kyoto targets. China instead is assumed to agree to a 10 per cent reduction of emissions with respect to the business-as-usual (BAU) scenario if it accepts to participate in a coalition (and thus in emissions trading). If various subglobal coalitions form, then they are assumed to behave independently, without a link between them (that is, there is no trade between all regional blocs in a common market).

Using the FEEM-RICE model, we will analyse the costs and benefits of moving away from the present situation where the EU, Japan and Russia are committed to complying with their Kyoto targets and where the other countries/regions are free to determine their own climate policy unilaterally. Therefore, our benchmark case, or business-as-usual scenario, to which we compare different potential bottom-up climate regimes, is the coalition formed by the Annex B_{-US} countries (that is, the Annex B countries minus the US).

We will explore the economic and environmental implications of three possible two-bloc climate regimes. In the first climate regime, one coalition (bloc) is formed by the EU and Russia, the second one by Japan and China. In the second regime, the first bloc is formed by the EU and Japan, whereas the second one is formed by the US and Russia. Finally, we will analyse the case in which the Annex B_{-US} bloc is complemented by a parallel bloc

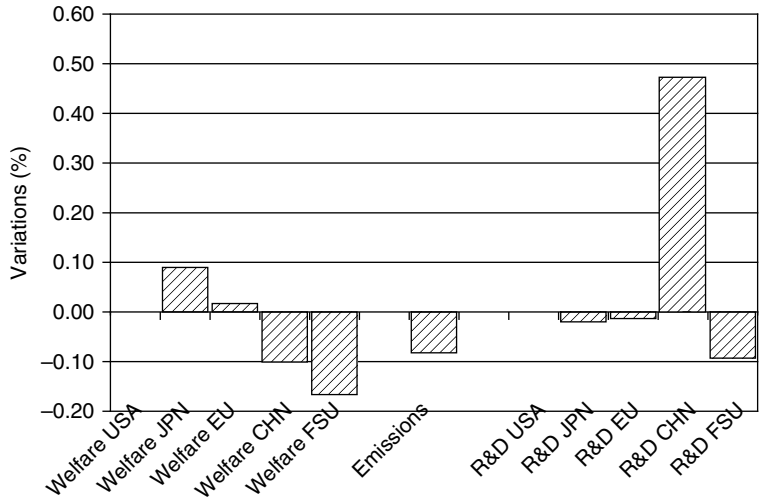
formed by the US and China. We will focus on changes of the main economic variables (welfare, as measured by discounted future consumption levels, R&D expenditure, global CO_2 emissions and abatement costs, for which an indicator is the equilibrium price in the permit market) with respect to the business-as-usual scenario. In all scenarios, the Rest of the World is assumed to be exempted by emission abatement commitments and therefore does not participate in any coalitions. The reason is that the inclusion of the least-developed countries is very unlikely in the next stages of climate negotiations. The time horizon over which climate policy is optimized is 2010–2100.

2.1.1 A Two-Bloc Coalition Structure: the EU with Russia, and Japan with China

The first case that we analyse using the FEEM-RICE model is the one in which two blocs emerge out of climate negotiations. Let us assume that the US continues to adopt its own unilateral climate policy. What will the other countries do after 2012? One possibility is the formation of two regional climate blocs: one in Europe, formed by the EU and Russia, the other one in the Far East, formed by Japan and China.

Russia has a strong interest in intensifying its relations with Europe, not only in order to improve its economic performance, but also to strengthen its political role within an enlarged, unified Europe. Cooperation on climate policy could demonstrate that Russia is indeed willing and prepared to bear responsibility, and would thus be an important step in the direction of Western Europe. The recent (2004) ratification of the Kyoto Protocol by the Putin administration confirms this political trend. Therefore, a scenario is which the EU and the FSU closely cooperate on climate seems to be likely, whereas there is increasing emphasis in Japan in favour of regional economic cooperation in East Asia and above all with China. Therefore, as part of its efforts to foster cooperation with China, Japan could also propose a deal concerning GHG emission reduction.

The cooperation between China and Japan seems to be plausible because it would quite plausibly enhance the role of their geographical area and thus give the two countries stronger political weight. In addition, this cooperation could enable Japan to reduce its high abatement costs, China to improve its environmental performance and at the same time to profit from selling permits in the bilateral emissions trading market. Since China officially demonstrates its 'strong expectations of advanced Japanese environmental protection technologies to combat its own environmental problems' (*Japan Times*, 2002), a 'win–win case' could be established if China could improve its environmental protection with Japanese assistance, while



Key: R&D = research and development; CHN = China; EU = Europe; FSU = Former Soviet Union; JPN = Japan.

Figure 2.1 A climate regime with two blocs: (1) the EU and the FSU; (2) Japan and China

Japan could reach its Kyoto emissions reduction target at a lower cost by cooperating with China.

Figure 2.1 illustrates the main economic and environmental consequences of a regime based on two regional blocs: the EU and the FSU on the one hand, Japan and China on the other.

From Figure 2.1, it is clear that, with respect to the Annex B_{-US} case, China and the FSU are the two losers; China because it moves from free-riding to climate change cooperation, even though its abatement target is close to what it would be in a business-as-usual scenario.[8] The welfare loss of the FSU is even stronger because Japan no longer buys permits from the FSU. Therefore, the permit price in the bilateral market with the EU becomes very low with respect to the price when the Annex B_{-US} coalition forms (−25.2 per cent). As a consequence, the EU reduces its abatement costs through a lower permit price induced by the reduced demand compared to the benchmark case.

Japan is the main winner in this scenario. Japan gains because it can buy cheaper permits from China, since the permit price falls in comparison to the 'Kyoto forever' regime where the Annex B_{-US} coalition forms (in particular, the permit price in this market is 86.1 per cent lower than in the benchmark case).

With respect to the Annex B_{-US} case, China increases its strategic R&D investments in order to have a greater supply of permits at its disposal, since a greater supply of permits implies an increase in its benefits from selling the permits on the emissions market. In contrast, the FSU reduces R&D investments because the profitability of the bilateral permit market with the EU is much lower than the profitability of the permit market where Japan is also a buyer. Total emissions become smaller because of the increased abatement in China.

Therefore, when compared to our benchmark case, this two-bloc climate regime is profitable both to the EU and to Japan, which could therefore implement some compensation schemes to offset the losses incurred by China and above all by the FSU. However, when compared with the coalition formed by Annex B_{-US} + China, the two-bloc regime does not yield a positive welfare change for any of the cooperating countries.[9] Therefore, on the basis of economic incentives, the two-bloc climate regime just analysed does not seem to be likely. Still, this regime is more environmentally effective than both the Annex B_{-US} + China regime and the 'Kyoto forever' one.

The above analysis has not yet taken into account the role of the US. Is the US going to remain 'stand-alone' and to implement a domestic climate policy, which is likely to only achieve non-cooperative emission abatement levels? Or will the US counter-propose bilateral or trilateral deals with some other countries or regions in order to reduce its abatement costs and increase environmental effectiveness?

At the moment, the US is outside the Kyoto framework and has announced its alternative Climate Change Research Initiative. Even though the most obvious immediate US reaction lies in a domestic abatement programme, other US moves are likely, and these may induce the emergence of other types of coalitions. As soon as the US realizes that a large amount of emissions abatement must be undertaken, it will also realize that these emissions reductions are too costly if undertaken through domestic measures only. US industrial groups fear they may not qualify for incentives that Kyoto countries use to promote emissions reductions (*Washington Times*, 2002). Moreover, the US has significant economic and strategic as well as environmental interests in joining the international cooperative effort to control climate change, since it cannot afford to remain on the sidelines while others design a global climate regime (Stewart and Wiener, 2003).

As reported in the international press, an early proposal aims at establishing a scheme based on a cap on emission levels and awards for permits under the North American Free Trade Agreement (NAFTA). This alternative would imply that the US, Canada and Mexico were participants in a cross-border trading scheme. The establishment of a regional trading

system under the NAFTA has above all been urged by private sector advisers.[10]

Other signs of an active international US role are the US–Australia Climate Action Partnership, an initiative consisting of various programmes aimed at improving scientific cooperation in areas including climate change science, reduced emissions strategies and engagement with business on technology to reduce GHG emissions. A similar partnership between the US and Japan is aimed at promoting joint projects and exchanging opinions on various measures to prevent global warming, and there is a comparable US–India technology cooperation project.

The most obvious signal that the US seeks alternatives to respond to the criticism related to its withdrawal from the Kyoto Protocol (without losing face domestically) is its participation in the Asia-Pacific Partnership on Clean Development and Climate, launched in July 2005. This agreement – signed by the US, Australia, Japan, China, India and South Korea – constitutes a voluntary, technology-based initiative to reduce greenhouse gas emissions without legally binding emissions targets. Its basic idea is to cooperate to develop new technologies and to deploy these technologies in developing countries.

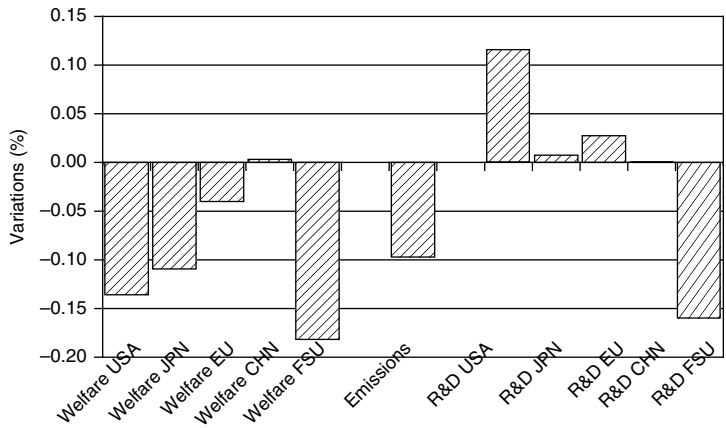
A further step in the US strategy could thus consist in offering a partnership to large emissions permit suppliers, as for example the FSU or China. In order to improve its performance in the emissions market, the US could offer the FSU or China better conditions than those offered by the EU and Japan. Let us therefore analyse these two scenarios.

2.1.2 A Second Two-Bloc Coalition Structure: the US with Russia and the EU with Japan

What would be the consequences of a climate regime in which the US and the FSU cooperate[11] without the EU and Japan, while these two countries remain committed to their Kyoto obligations?

As shown by Figure 2.2, this two-bloc climate regime is certainly environmentally effective – emissions decrease by 10 per cent with respect to the benchmark – but it is not likely to emerge, because the total welfare of all cooperating countries becomes lower. Only China improves its welfare, because more abatement is undertaken at the world level. However, China's welfare in this two-bloc regime is again lower than its welfare in the coalition formed by Annex B_{-US} + China (see Buchner and Carraro, 2006a).

The reason for the reduced welfare in the EU and Japan is fairly evident. Their abatement costs largely increase because they can no longer exploit the lower abatement costs in the FSU (the permit price in the EU–Japan



Key: R&D = research and development; CHN = China; EU = Europe; FSU = Former Soviet Union; JPN = Japan.

Figure 2.2 A second climate regime with two blocs: (1) the US and the FSU; (2) the EU and Japan

market increases by 220.6 per cent with respect to the benchmark 'Kyoto forever' case).

The reason for the reduced welfare in the US depends on our choice of the benchmark. We are comparing a situation in which the US cooperates with the FSU with a situation in which it free-rides (the Annex B_{-US} coalition). Therefore, even though it can take advantage of the FSU's 'hot air', its costs obviously increase because it increases its abatement effort with respect to the free-riding abatement effort. For the same reason, US welfare is also lower if compared with its welfare when the coalition (Annex B_{-US} + China) forms.

Finally, the FSU's welfare also decreases because marginal abatement costs in the US are lower than in Japan and the EU. Therefore, the permit price in the US–FSU market is lower (–25.2 per cent) than in the EU–Japan–FSU market. As a consequence, the FSU reduces its revenue from selling permits. In addition, the incentive to undertake strategic R&D is lower than in the benchmark case. Hence, R&D in the FSU is lower, thus lowering the supply of permits. R&D is instead much higher in the US, which is faced with a real incentive to abate emissions at low cost.

Summing up, this climate regime is unlikely to emerge because of the lack of economic incentives, even though the cooperation within the two blocs is more environmentally effective than cooperation within the 'Kyoto forever' coalition.

Let us therefore explore a third scenario, where again a two-bloc climate regime forms. This scenario originates from two basic facts: (1) it is unlikely that a US strategy could break the Annex B_{-US} bloc, due both to political reasons and the lack of economic incentives just described; (2) in the US, the involvement of developing countries in a cooperative climate regime is seen as crucial to achieving long-term goals. Therefore, in order to reduce its abatement costs and increase its domestic political credibility, the US could negotiate an agreement with China, thus giving rise to an emissions trading market where the equilibrium permit price would be low. The climate regime would then be formed by the following two blocs: US and China on the one hand, and the EU, Japan and the FSU on the other.

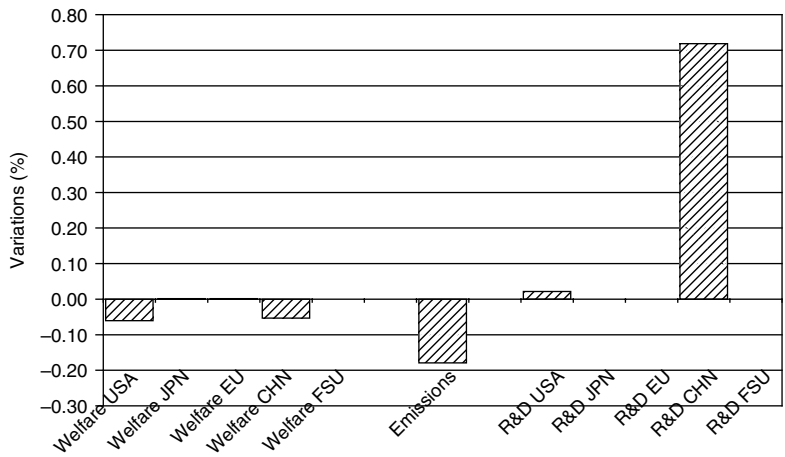
2.1.3 A Third Two-Bloc Coalition Structure: US with China and EU with Russia and Japan

There is some evidence that this regime may not be unrealistic. China's decision to ratify the Kyoto Protocol demonstrates that the country is aware that benefits from ratification could be high because China is the largest permit seller. In addition, recent signals from China suggest that the government might even change its position regarding binding commitments, indicating that China might accept, under appropriate conditions, binding GHG reduction targets. The ratification of the Kyoto Protocol in its actual form could therefore be interpreted more as a long-term commitment to emissions control than as a short-run strategy to reap the benefits on the emissions trading market.

With mild binding abatement targets and given the consequent large amount of permits which can be supplied, China is a very attractive partner in climate change control activities. This is why the US could be tempted to convince China to cooperate under a joint climate pact. In this way, the US could achieve two goals: (1) satisfy domestic political requirements by involving developing countries in their climate strategy; (2) reap high benefits from a large joint emissions market (the US and China together account for more than one-third of the worldwide CO_2 emissions and this share is becoming larger). In particular, the US could drastically decrease its abatement costs through emissions trading and China could profit from selling a large amount of permits.

What would then be the main consequences of a two-bloc climate regime with a first bloc formed by the EU, Japan and the FSU (the Kyoto coalition) and a second bloc formed by the US and China? Some of these consequences are shown in Figure 2.3.

First of all, it is clear that both the US and China lose with respect to the case in which they free-ride. However, the loss for the US is small and could



Key: R&D = research and development; CHN = China; EU = Europe; FSU = Former Soviet Union; JPN = Japan.

Figure 2.3 A third climate regime with two blocs: (1) the US and China; (2) the EU, the FSU and Japan

be largely compensated for by some ancillary benefits from GHG emissions abatement that are not taken into account in our model.

The loss for China is also small – and even smaller when compared to the regime in which the coalition (Annex B_{-US} + China) forms – and ancillary benefits, both on the environmental and economic side, could be large. Note that this climate regime is the one most preferred by both the US and China when they do not free-ride. Namely, it is the most preferred among those in which they undertake some cooperative emissions abatement.

The inclusion of China in a coalition with the US is slightly beneficial for the Kyoto climate bloc consisting of the European Union, Japan and the FSU, because of the enhanced environmental effectiveness of this two-bloc regime. Indeed, GHG emissions are almost 20 per cent lower than in the benchmark case, and also lower with respect to total emissions in the climate regime in which the coalition (Annex B_{-US} + China) forms. However, the coalition (Annex B_{-US} + China) is the most preferred by the EU and Japan, because the absence of China from the coalition increases marginal abatement costs and thus induces welfare losses for the EU and Japan.

This two-bloc climate regime is characterized again by a large expansion of China's R&D investments. China overinvests in R&D to increase its sales in the bilateral emissions trading market. The segmentation of the trading market also explains why R&D investments within the benchmark

Annex B_{-US} coalition do not change. However, if the comparison is made with the coalition (Annex B_{-US} + China), then it can be seen that R&D investments in this climate regime are higher for all Annex B_{-US} countries. The reason is again the larger marginal abatement costs when China is not a seller in the permit market. This induces higher investments in R&D in the EU and Japan, and also strategic R&D investments in the FSU, which will find it optimal to increase its supply of permits.

Before attempting to draw some policy lessons from our analysis, let us briefly summarize the findings of the three potential post-2012 scenarios investigated in this section. The first scenario is profitable to Japan and the EU which could therefore implement some compensation scheme for China and Russia. However, given the absence of the US in this regime, it is quite unlikely to emerge. The second scenario implies a decrease of total welfare in all involved countries, and given this lack of incentives is equally unlikely to emerge. The third post-2012 scenario appears more likely to emerge, as it causes small welfare losses for the US and China and small welfare gains for the Annex B_{-US}, while leading to a considerably enhanced environmental effectiveness of climate policy.

2.2 PARTICIPATION IN A BOTTOM-UP CLIMATE REGIME: A POLICY ANALYSIS

In the previous section, three two-bloc climate regimes have been identified as possible evolutions of the present situation in which the Annex B_{-US} countries – the EU, the FSU and Japan – cooperate to reduce GHG emissions. Costs and benefits of a move from this benchmark regime to a new one have been discussed. From this cost–benefit analysis the following conclusions can be drawn.

First of all, our analysis has evidenced that the two countries which have been criticized for not participating in the international climate efforts – the US and China – face a strong incentive to free-ride. Given their national circumstances, both countries clearly prefer to set their environmental policy unilaterally, thus profiting from the abatement levels set by the Kyoto coalition countries. Their decision not to adopt binding abatement targets therefore seems a rational one.

Second, the US decision to withdraw from Kyoto appears to have had a beneficial economic effect on the remaining industrialized countries, namely the European Union and Japan. In particular, the US ratification of the Kyoto Protocol would not provide benefits to the EU and Japan, which would increase their abatement costs. Indeed, the EU and Japan have a strong incentive to maintain cooperation with Russia (or to profit from

the participation of another large emissions permit supplier) without the US on the demand side of the market.

Third, the frequently criticized absence of an additional large permit supplier like China seems to be beneficial for the current main permit seller on the Kyoto market, namely Russia: that is, Russia has an economic incentive to keep large developing countries out of the climate coalition for as long as possible.

These remarks provide an economic explanation for the emergence of the current climate regime, suggesting that the climate coalition structure where only the EU, Japan and the FSU cooperate is fairly stable in terms of economic incentives. However, it is widely acknowledged that the current situation is highly ineffective from an environmental viewpoint, both because major GHG emitters are not involved, and because several provisions have watered down the contents of the Kyoto Protocol in order to ensure its ratification.

As a consequence, a move from the current climate regime would be welcome, although unlikely, at least in terms of economic cost and benefits. What then are the prospects for a move to a new global climate regime? From a political viewpoint, it is unlikely that the US and large developing countries will keep rejecting any form of climate cooperation. The scientific evidence on the potentially significant impacts of climate change is growing stronger, supported by an increase in the frequency and scope of extreme events. The political pressure is therefore expected to grow until at a certain point all countries need to accept a global climate regime.

Yet, the way towards a global climate policy still seems long and rocky, particularly because of the opposing US position. Can the decision about effective GHG abatement measures be delayed? Recent research (see for example Meinshausen et al., 2006; Höhne et al., 2005; Azar and Schneider, 2002) suggests that a delay in mitigation activities would be costly in terms of direct abatement costs, irreversible damage, and the potential foreclosure of reaching certain climate goals. To avoid crossing the so-called 'point of no return' before implementing an effective climate policy, near-term mitigation policies are an indispensable step to keep rigorous targets within reach. In particular, even though a global climate policy should be the final goal to cope appropriately with a problem like global climate change, measures should be adopted to ensure that (at least) all major countries start to engage systematically in climate change efforts.

Therefore, the participation of the US and China is indispensable, even in the near term, for a successful attempt to control climate change, as they are responsible for a significant share of the global greenhouse gas emissions. It is also clear that neither of the two countries would participate in international climate policy without the involvement of the other. As a

consequence, it is crucial to propose a policy architecture in which these two countries are led to cooperate to reduce their own prospective GHG emissions.

Our analysis has contributed to this objective. Looking at the specific costs and benefits of the US and China, we have found that a fragmented regime with two parallel coalitions might be the least opposed (in terms of net economic benefits), because it induces small economic losses in the US and China and large global environmental benefits at the same time. Most importantly – and although being very different – the US and China share interests and objectives and would therefore prefer, at least as a first step, to cooperate without any further partners if they were asked to engage in an international climate regime characterized by cap and trade.

Therefore, if for some environmental, economic or political reasons the US and China decide to cooperate to control their GHG emissions, they may sign a bilateral agreement rather than joining a large global coalition. This situation, which corresponds to the coalition structure [(JPN, EU, FSU), (USA, CHN)], slightly increases welfare in the EU, Japan and the FSU, at least with respect to the present Kyoto coalition (see Figure 2.3). Therefore, the Annex B_{-US} countries may accept a two-bloc regime, where the US and China cooperate on emissions abatement and trade permits in a bilateral permit market.

2.3 CONCLUSIONS

Climate strategies can usually be designed according to two overall climate policy approaches that represent two rough categories, each encompassing a rich variety of detailed methods. The first approach is referred to as 'top-down', in which climate policy targets are usually negotiated in an international arena, for all participating countries. The focus is thus on the world as a whole (or at least a number of interacting regions), imposing climate policies within this larger system. The second approach is referred to as 'bottom-up', meaning that international climate policy evolves by adding up climate policies implemented at a lower level, usually country levels, each considered independently in the beginning. The focus is on a bottom-up, country-driven approach to defining national commitments. Obviously, each of these two approaches to climate policy has its strengths and weaknesses, and a trade-off between the more comprehensive top-down approach and the more detailed and focused bottom-up approach exists.

Since the first negotiations on climate change control in 1979,[12] the design of climate policy has been top-down, as is shown by the history of international negotiation rounds under the United Nations Framework

Convention on Climate Change (UNFCCC). This approach to climate policy has led to a certain deadlock in negotiations, which has consequently induced the search for more successful policy architectures. Recent negotiations and policy developments suggest that it might be difficult to achieve a single global agreement, and that regional or sub-global agreements are more likely to emerge (see, for example, Buchner and Carraro, 2007; Egenhofer and Legge, 2001; Stewart and Wiener, 2003; Victor, 2006).

Our analysis has contributed to the understanding of the economic implications of some bottom-up regimes, in which more than a single climate coalition may emerge. In particular, we suggest that participation in a cooperative effort to control GHG emissions may be favoured if countries are free to form more than one coalition, thus leading to a set of regional and/or sub-global climate blocs. This process is likely to be similar to the one characterizing the recent evolution of trade negotiations and the consequent emergence of several regional trade blocs. This approach to climate policy may gradually be able to induce most major emitting countries to cooperate to reduce their own GHG emissions. Although a set of sub-global agreements would not be a first-best solution to the climate problem, parallel bottom-up coalitions could be a first step towards global climate change control. Our analysis has shown that countries may have an interest in this approach and that, given the potentially dangerous implications of climate change, it should be considered as a viable, fruitful possibility to increase the participation in the cooperative effort to control climate change.

NOTES

1. This chapter is part of the research work being carried out by the Climate Change Modelling and Policy Unit at Fondazione Eni Enrico Mattei. The authors are grateful to Igor Cersosimo and Carmen Marchiori for valuable research assistance and to Christian Egenhofer, Ariel Dinar, Frank Convery, Johan Eyckmans, Richard Newell, and to the participants in the 2nd World Congress of Environmental Economists in Monterey, 24–27 June 2002, the ECF Annual Conference in Berlin, 13–15 November 2002, the ESRI International Conference in Tokyo, 27–28 February 2003, the Conference on Post 2012 Climate Policy: Architectures and Participation Scenarios in Venice, 20–21 June 2005, the EAERE 2005 in Bremen, 23–26 June 2005, for suggestions and remarks. The usual disclaimer applies.
2. As has been stressed by Egenhofer and Legge (2001), 'it is increasingly becoming clear, [that] the Kyoto Protocol is less a global agreement than a set of differing regional approaches'. See also Victor (2006) for a convincing analysis of the fragmentation of the present climate regime.
3. The strong increase in the number of trade bloc agreements registered with the World Trade Organization (WTO) is discussed in Tjornhom (2000) and Boonekamp (2003). Some 250 regional trade agreements (RTAs) have been notified to the General Agreement on Tariffs and Trade (GATT) and consequently the WTO up to December

2002, of which 130 were notified after January 1995. About 200 RTAs are currently in force. An additional 70 to 100 are estimated to be operational although not yet notified. RTAs, which include bilateral free trade agreements between countries that are not in the same region, have become so widespread that all but one WTO member are now parties to one or more of them. Indeed, as of August 2006, all 146 WTO members, with the exception of Mongolia, participate in or are actively negotiating regional trade agreements.

4. The groupings that are important for the WTO are those that abolish or reduce barriers to trade within the group. The WTO agreements recognize that regional arrangements and closer economic integration can benefit countries. It also recognizes that under some circumstances regional trading arrangements could hurt the trade interests of other countries. Normally, setting up a customs union or free trade area would violate the WTO's principle of equal treatment for all trading partners (the 'most-favoured nation' (MFN) clause is a provision in a commercial treaty binding the signatories to extend trading benefits equal to those accorded to any third state. The clause ensures equal commercial opportunities, especially concerning import duties and freedom of investment, and is meant to promote free trade). But GATT's Article 24 allows regional trading arrangements to be set up as a special exception, provided certain strict criteria are met. In particular, the arrangements should help trade flow more freely among the countries in the group without barriers being raised on trade with the outside world. In other words, regional integration should complement the multilateral trading system and not threaten it.
5. Note that, in all climate regimes, abatement is a strategic value which is optimally set at its welfare-maximizing level.
6. Please note also that our analysis focuses only on CO_2. There are other greenhouse gases and the Kyoto Protocol takes some of them into account. Moreover, both the Bonn agreement and the subsequent Marrakesh deal emphasize the role of sinks in meeting the Kyoto targets. As shown by several recent analyses (for example Manne and Richels, 2001; Jensen and Thelle, 2001), the inclusion of the other greenhouse gases and of sinks would further reduce mitigation costs.
7. The use of the 'Kyoto forever' hypothesis may be seen as a strong assumption. However, the CO_2 concentration levels implicit in this assumption (if FEEM-RICE is a good description of the world) coincide with those in the A1B scenario (IPCC, 2001) which can be considered the 'median' scenario among those currently proposed. We thus use the 'Kyoto-forever' hypothesis not because it represents a realistic scenario, but as a benchmark with respect to which policy alternatives can be compared. The A1B scenario belongs to the A1 storyline and scenario family developed by the IPCC in its Special Report on Emission Scenarios (SRES). This scenario group is characterized by very rapid economic growth, a global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. The A1B scenario group distinguishes itself from the other A1 scenarios in that it assumes a 'balanced' approach across all energy sources, not relying therefore too heavily on one particular technology.
8. We assume that China agrees to a 10 per cent reduction of emissions with respect to the BAU scenario over the whole time horizon.
9. The economic implications of the coalition formed by the Annex B_{-US} countries and by China are analysed in Buchner and Carraro (2006).
10. In Canada, which is still a partner in the Umbrella Group, industry is also asking for clarification regarding the economic consequences of implementing the Kyoto Protocol without the US. The Canadian government recognizes the difficulties that arise from the linked nature of the American and Canadian economies, but is still supportive of the agreement (the Kyoto Protocol was ratified by Canada in December 2002).
11. The United States and Russia said on 17 January 2003 that they would seek a common approach to battling global warming. The first meeting of the Russian–American intergovernmental workgroup looking into climatic changes took place in Moscow in April 2003.

12. In 1979, the First World Climate Conference was organized by the World Meteorological Organization (WMO) in Geneva.

REFERENCES

Aldy, J.E., J. Ashton, R. Baron, D. Bodansky, S. Charnovitz, E. Diringer, T.C. Heller, J. Pershing, P.R. Shukla, L. Tubiana, F. Tudela and X. Wang (2003a), 'Beyond Kyoto: advancing the international effort against climate change', Pew Center on Global Climate Change.

Aldy, J.E., S. Barrett and R.N. Stavins (2003b), 'Thirteen plus one: a comparison of global climate policy architectures', *Climate Policy*, **3** (4), 373–97.

Azar, C. and S.H. Schneider (2002), 'Are the economic costs of stabilizing the atmosphere prohibitive?' *Ecological Economics*, **42**, 73–80.

Baldwin, R. (1993), 'A domino theory of regionalism', NBER Working Paper No. 4465.

Baldwin, R. (1997), 'The causes of regionalism', *World Economy*, **20** (7), 865–88.

Barrett, S. (1994), 'Self-enforcing international environmental agreements', *Oxford Economic Papers*, **46**, 878–94.

Barrett, S. (2001), 'Towards a better climate treaty', *Policy Matters*, 01-29, Washington, DC: AEI-Brookings Joint Center for Regulatory Studies.

Baumert, K., O. Blanchard, S. Llosa and J. Perkaus (eds) (2002), *Building on the Kyoto Protocol: Options for Protecting the Climate*, Washington, DC: World Resources Institute (WRI).

Bloch, F. (1995), 'Endogenous structures of associations in oligopolies', *RAND Journal of Economics*, **26**, 537–56.

Bloch, F. (1996), 'Sequential formation of coalitions in games with externalities and fixed payoff division', *Games and Economic Behavior*, **14**, 90–123.

Bloch, F. (2003), 'Noncooperative models of coalition formation in games with spillovers, in C. Carraro (ed.), *The Endogenous Formation of Economic Coalitions*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.

Bloch, F. and H. Ferrer (1999), 'Trade fragmentation and coordination in bilateral oligopolies', CORE Discussion Paper No. 9908.

Bodansky, D. (2004), 'International climate efforts beyond 2012: a survey of approaches', prepared for the Pew Center on Global Climate Change, with contributions from Sophie Chou and Christie Jorge-Tresolini.

Bond E. and C. Syropoulos (1996), 'The size of trading blocs: market power and world welfare effects', *Journal of International Economics*, **40**, 417–37.

Boonekamp, C. (2003), 'The changing landscape of RTAs', WTO Secretariat, Trade Policies Review Division, prepared for the seminar on Regional Trade Agreements and the WTO, WTO Secretariat, Geneva, 14 November.

Botteon, M. and C. Carraro (1997), 'Burden-sharing and coalition stability in environmental negotiations with asymmetric countries', in C. Carraro (ed.), *International Environmental Agreements: Strategic Policy Issues*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.

Buchner, B. and C. Carraro (2006), 'US, China and the economics of climate negotiations', *International Environmental Agreements: Politics, Law and Economics*, **6** (1), 63–89.

Buchner, B. and C. Carraro (2007), 'Parallel climate blocs: incentives to cooperation in international climate negotiations', mimeo, forthcoming in R. Guesnerie and H. Tulkens (eds), *The Design of Climate Policy*, Cambridge, MA: MIT Press.
Buonanno, P., C. Carraro and M. Galeotti (2002), 'Endogenous induced technical change and the costs of Kyoto', *Resource and Energy Economics*, **524**, 11–35.
Carraro, C. (1998), 'Beyond Kyoto: a game theoretic perspective', in the Proceedings of the OECD Workshop on Climate Change and Economic Modelling: Background Analysis for the Kyoto Protocol, Paris, 17–18 September.
Carraro, C. (1999), 'The structure of international agreements on climate change', in C. Carraro (ed.), *International Environmental Agreements on Climate Change*, Dordrecht: Kluwer Academic Publishing.
Carraro, C. and C. Marchiori (2003), 'Stable coalitions', in C. Carraro (ed.), *The Endogenous Formation of Economic Coalitions*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.
Carraro, C. and D. Siniscalco (1993), 'Strategies for the international protection of the environment', *Journal of Public Economics*, **52**, 309–28.
Casella, A. (1995), 'Large countries, small countries and the enlargement of trade blocs', NBER Working Paper No. 5365.
CNRS/LEPII-EPE, RIVM/MNP, ICCS-NTUA and CES-KUL (2003), 'Greenhouse gas reduction pathways in the UNFCCC process up to 2025; Policymakers Summary', study prepared for DG Environment, available at http://europe.eu.int/comm/environment/climat/studies.htm.
Coe, D.T. and E. Helpman (1995), 'International R&D spillovers', *European Economic Revie*w, **39**, 859–87.
Egenhofer, C. and T. Legge (2001), 'After Marrakech: the regionalisation of the Kyoto Protocol', CEPS Commentary.
Egenhofer, C., W. Hager and T. Legge (2001), 'Defining Europe's near abroad in climate change: a Russian–EU alliance – sub-global bargaining to further international environmental agreements', CEPS Discussion Paper.
Eyckmans, J. and H. Tulkens (2002), 'Simulating coalitionally stable burden sharing agreements for the climate change problem', CORE Discussion Paper 9926 and CLIMNEG Working Paper 18, Université Catholique de Louvain, Belgium.
Finus, M. and B. Rundshagen (2003), 'Endogenous coalition formation in global pollution', in C. Carraro (ed.), *The Endogenous Formation of Economic Coalitions*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.
Goulder, L.H. and K. Mathai (2000), 'Optimal CO_2 abatement in the presence of induced technological change', *Journal of Environmental Economics and Management*, **39**, 1–38.
Griliches, Z. (1979), 'Issues in assessing the contribution of R&D to productivity growth', *Bell Journal of Economics*, **10**, 92–116.
Griliches, Z. (1984), *R&D, Patents, and Productivity*, Chicago, IL: University of Chicago Press.
Höhne, N., D. Phylipsen, S. Ullrich and K. Blok (2005), 'Options for the second commitment period of the Kyoto Protocol', ECOFYS GmbH, Cologne, Federal Environmental Agency, Germany.
IPCC (2001), *Third Assessment Report*, Cambridge: Cambridge University Press.
Japan Times (2002), 'China could help Japan by taking its money and cutting its Kyoto target', 26 January, online at www.japantimes.com.
Jensen, J. and M.H. Thelle (2001), 'What are the gains from a multi-gas strategy?' FEEM Working Paper 84.01, Milan.

Kopp, R., R. Morgenstern, W. Pizer and M. Toman (1999), 'A proposal for credible early action in US climate policy', RFF, Washington, DC.
Krugman, O. (1991), 'Is bilaterism bad?' in E. Helpman and A. Razin (eds), *International Trade and Trade Policy*, Cambridge, MA: MIT Press.
Manne, A. and R. Richels (1999), 'The Kyoto Protocol: a cost-effective strategy for meeting environmental objectives?' in J. Weyant (ed.), *The Cost of the Kyoto Protocol: A Multi-Model Evaluation*, Special Issue of the *Energy Journal*.
Manne, A.S. and R.G. Richels (2001), 'US rejection of the Kyoto Protocol: the impact on compliance costs and CO_2 emissions', Working Paper 01-12, AEI-Brookings Joint Center for Regulatory Studies.
McKibbin, W.J. and P.J. Wilcoxen (1997), 'A better way to slow global climate change', Brookings Institution Policy Brief, July.
Meinshausen, M., B. Hare, T.M.L. Wigley, D. van Vuuren, M.G.J. den Elzen and R. Swart (2006), 'Multi-gas emissions pathways to meet climate targets', *Climatic Change*, **75** (1–2), 151–94.
Nordhaus, W.D. (1999), 'Modelling induced innovation in climate-change policy', paper presented at the IIASA Workshop on Induced Technological Change and the Environment, Laxenburg, 21–22 June.
Nordhaus, W.D. (2001), 'After Kyoto: alternative mechanisms to control global warming', presentation at the 20th Anniversary Meeting of the International Energy Workshop, IIASA, Laxenburg, Austria.
Nordhaus, W.D. and Z. Yang (1996), 'A regional dynamic general-equilibrium model of alternative climate-change strategies', *American Economic Review*, **4**, 741–65.
OECD/IEA (2002), *Beyond Kyoto: Energy Dynamics and Climate Stabilisation*, Paris: OECD/IEA.
Pizer, W. (1999), 'Choosing price or quantity controls for greenhouse gases', Climate Issues Brief No. 17, Resources for the Future, Washington, DC.
Ray, D. and R. Vohra (1997), 'Equilibrium binding agreements', *Journal of Economic Theory*, **73**, 30–78.
Ray, D. and R. Vohra (1999), 'A theory of endogenous coalition structures', *Games and Economic Behavior*, **26**, 286–336.
Reinstein, R.A. (2004), 'A possible way forward on climate change', mimeo, Reinstein & Associates Inc.
Romer, P. (1990), 'Endogenous technological change', *Journal of Political Economy*, **94**, 1002–37.
Sampson, G. and S. Woolcock (2003), *Regionalism, Multilateralism, and Economic Integration. The Recent Experience*, Tokyo: United Nations University Press.
Stewart, R. and J. Wiener (2003), *Reconstructing Climate Policy*, Washington, DC: American Enterprise Institute Press.
Tjornhom, J. (2000), 'Dynamic trade bloc formation: building blocs or stumbling blocs?' University of Minnesota.
Victor, D. (2006), 'Fragmented carbon markets and reluctant nations: implications for the design of effective architectures', paper presented at the international workshop on Architectures for Agreement: Addressing Global Climate Change in the Post-Kyoto World, Harvard University, 12–13 May.
Washington Times (2002), Overseas, 'US firms warm up to Kyoto', 24 January, online at www.washtimes.com.
Weyant, J.P. (1997), 'Technological change and climate policy modeling', paper presented at the IIASA Workshop on Induced Technological Change and the Environment, Laxenburg, 26–27 June.

Weyant, J.P. and T. Olavson (1999), 'Issues in modelling induced technological change in energy, environmental, and climate policy', *Environmental Modelling and Assessment*, **4**, 67–85.
Yi, S.-S. (1996a), 'Endogenous formation of customs unions under imperfect competition: open regionalism is good', *Journal of International Economic*s, **41**, 153–77.
Yi, S.-S. (1996b), 'Open regionalism and world welfare', *Eastern Economic Journal*, **22** (4), Fall, 467–75.
Yi, S.-S. (1997), 'Stable coalition structures with externalities', *Games and Economic Behavior*, **20**, 201–23.
Yi, S.-S. (2003), 'Endogenous formation of economic coalitions: a survey of the partition function approach', in C. Carraro (ed.), *Endogenous Formation of Economic Coalitions*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.
Yi, S.-S. and H. Shin (1995), 'Endogenous formation of coalitions: oligopoly', mimeo, Department of Economics, Dartmouth College.

APPENDIX: THE FEEM-RICE MODEL

The FEEM-RICE model is an extension of Nordhaus and Yang's (1996) regional RICE model of integrated assessment, which is one of the most popular and manageable integrated assessment tools for the study of climate change (see, for instance, Eyckmans and Tulkens, 2002). It is basically a single-sector optimal growth model which has been extended to incorporate the interaction between economic activities and climate. One such model has been developed for each macro region into which the world is divided (the USA, Japan, Europe, China, the Former Soviet Union, and the Rest of the World).

Within each region a central planner chooses the optimal paths of fixed investment and emission abatement that maximize the present value of per capita consumption. Output (net of climate change) is used for investment and consumption and is produced according to constant returns Cobb-Douglas technology, which combines the inputs from capital and labour with the level of technology. Population (taken to be equal to full employment) and technology levels grow over time in an exogenous fashion, whereas capital accumulation is governed by the optimal rate of investment. There is a wedge between output gross and net of climate change effects, the size of which is dependent upon the amount of abatement (rate of emission reduction) as well as the change in global temperature. The model is completed by three equations representing emissions (which are related to output and abatement), carbon cycle (which relates concentrations to emissions) and climate module (which relates the change in temperature relative to 1990 levels to carbon concentrations) respectively.

In our extension of the model, technical change is no longer exogenous. Instead, the issue of endogenous technical change is tackled by following the ideas contained in both Nordhaus (1999) and Goulder and Mathai (2000) and accordingly modifying Nordhaus and Yang's (1996) RICE model. Doing so requires the input of a number of additional parameters, some of which have been estimated using information provided by Coe and Helpman (1995), while the remaining parameters were calibrated so as to reproduce the business-as-usual scenario generated by the RICE model with exogenous technical change.

In particular, the following factors are included: first, endogenous technical change affecting factor productivity is introduced. This is done by adding the stock of knowledge in each production function and by relating the stock of knowledge to R&D investments. Second, induced technical change is introduced, by allowing the stock of knowledge to affect the emissions–output ratio as well. Finally, international technological spillovers are also accounted for in the model.

To determine the optimal value of all control variables, including their own GHG abatement strategy, countries play a non-cooperative Nash game in a dynamic setting, which yields an open-loop Nash equilibrium (see Eyckmans and Tulkens, 2002, for an explicit derivation of first-order conditions of the optimum problem). This is a situation in which, in each region, the planner maximizes social welfare subject to the individual resource and capital constraints and the climate module, given the emissions and investment strategies (in the base case) and the R&D expenditure strategy (in the endogenous technological change case) of all other players.

The Standard Model without Induced Technical Change

As previously mentioned, it is assumed for the purpose of this model that innovation is brought about by R&D spending which contributes to the accumulation of the stock of existing knowledge. Following an approach pioneered by Griliches (1979, 1984), it is assumed that the stock of knowledge is a factor of production, which therefore enhances the rate of productivity (see also the discussion in Weyant, 1997; Weyant and Olavson, 1999). In this formulation, R&D efforts prompt non-environmental technical progress, but with different modes and elasticities. More precisely, the RICE production function output is modified as follows:

$$Q(n,t) = A(n,t)K_R(n,t)^{\beta_n}[L(n,t)^{\gamma}K_F(n,t)^{1-\gamma}] \qquad (2A.1)$$

where Q is output (gross of climate change effects), A the exogenously given level of technology and K_R, L and K_F are respectively the inputs from knowledge capital, labour, and physical capital.

In (2A.1), the stock of knowledge has a region-specific output elasticity equal to β_n ($n = 1, \ldots 6$). It should be noted that, as long as this coefficient is positive, the output production process is characterized by increasing returns to scale, in line with current theories of endogenous growth. This implicitly assumes the existence of cross-sectoral technological spillovers within each country (Romer, 1990). In addition, it should be noted that while allowing for R&D-driven technological progress, we maintain the possibility that technical improvements can also be determined exogenously (the path of A is the same as that specified in the original RICE model). The stock accumulates in the usual fashion:

$$K_R(n,t+1) = R\&D(n,t) + (1-\delta_R)K_R(n,t) \qquad (2A.2)$$

where *R&D* is the expenditure in research and development and δ_R is the rate of knowledge depreciation. Finally, it is recognized that some resources are absorbed by *R&D* spending. That is:

$$Y(n,t) = C(n,t) + I(n,t) + R\&D(n,t) \tag{2A.3}$$

where Y is net output (net of climate change effects as specified in the RICE model), C is consumption and I gross fixed capital formation.

At this stage the model maintains the same emissions function as Nordhaus's RICE model which will be modified in the next section:

$$E(n,t) = \sigma(n,t)[1 - \mu(n,t)]Q(n,t) \tag{2A.4}$$

where σ can be loosely defined as the emissions–output ratio, E stands for emissions and μ for the rate of abatement effort. The policy variables included in the model are rates of fixed investment and of emissions abatement. For the other variables, the model specifies a time path of exogenously given values. Interestingly, this is also the case for technology level A and of the emissions–output ratio σ. Thus, the model presented so far assumes no induced technical change, that is, an exogenous environmental technical change, and a formulation of productivity that evolves both exogenously and endogenously. In the model, investment fosters economic growth (thereby driving up emissions) while abatement is the only policy variable used for reducing emissions.

Induced Technical Change

In the second step of our model formulation, endogenous environmental technical change is accounted for. It is assumed that the stock of knowledge – which in the previous formulation was only a factor of production – also serves the purpose of reducing, *ceteris paribus*, the level of carbon emissions. Thus, in the second formulation, R&D efforts prompt both environmental and non-environmental technical progress, although with different modes and elasticities. (Obviously, we could have introduced two different types of R&D efforts, respectively contributing to the growth of an environmental knowledge stock and a production knowledge stock. Such undertaking however is made difficult by the need to specify variables and calibrate parameters for which there is no immediately available and sound information in the literature.) More precisely, the RICE emissions–output relationship is modified as follows:

$$E(n,t) = [\sigma_n + \chi_n \exp(-\alpha_n K_R(n,t))][1 - \mu(n,t)]Q(n,t) \tag{2A.4'}$$

In (2A.4'), knowledge reduces the emissions–output ratio with an elasticity of α_n, which is also region-specific; the parameter χ_n is a scaling coefficient, whereas σ_n is the value to which the emissions–output ratio tends asymptotically as the stock of knowledge increases without limit. In this formulation, R&D contributes to output productivity on the one hand, and affects the emissions–output ratio – and therefore the overall level of pollution emissions – on the other.

Knowledge Spillovers

Previous formulations do not include the effect of potential spillovers produced by knowledge, and therefore ignore the fact that both technologies and organizational structures disseminate internationally. Modern economies are linked by vast and continually expanding flows of trade, investment, people and ideas. The technologies and choices of one region are and will inevitably be affected by developments in other regions.

Following the work of Weyant and Olavson (1999), who suggest that the definition of spillovers in an induced technical change context be kept plain and simple (in the light of a currently incomplete understanding of the problem), disembodied or knowledge spillovers are modelled (see Romer, 1990). They refer to the R&D carried out and paid for by one party that produces benefits to other parties which then have better or more inputs than before or can somehow benefit from R&D carried out elsewhere. Therefore, in order to capture international spillovers of knowledge, the stock of world knowledge is introduced in the third version of the FEEM-RICE model, both in the production function and in the emissions–output ratio equation. Equations (2A.1) and (2A.4') are then revised as follows:

$$Q(n,t) = A(n,t)K_R(n,t)^{\beta_n}WK_R(n,t)^{\varepsilon_n}[L(n,t)^{\gamma}K_F(n,t)^{1-\gamma}] \quad \text{(2A.1')}$$

and:

$$E(n,t) = [\sigma_n + \chi_n \exp(-\alpha_n K_R(n,t) - \theta_n WK_R(n,t))][1 - \mu(n,t)]Q(n,t) \quad \text{(2A.4")}$$

where the stock of world knowledge:

$$WK_R(j,t) = \sum_{j \neq i} K_R(i,t) \quad \text{(2A.5)}$$

is defined in such a way as not to include a country's own stock.

Emissions Trading

As mentioned above, throughout the analysis we assume the adoption of efficient policies. As a consequence, the model also includes the possibility of emissions trading. When running the model in the presence of emissions trading, two additional equations are considered:

$$Y(n,t) = C(n,t) + I(n,t) + R\&D(n,t) + p(t)NIP(n,t) \qquad (2A.3')$$

which replaces equation (2A.3) and:

$$E(n,t) = Kyoto(n) + NIP(n,t) \qquad (2A.6)$$

where $NIP(n,t)$ is the net demand for permits and $Kyoto(n)$ are the emission targets set in the Kyoto Protocol for the signatory countries and the BAU levels for the non-signatory ones. According to (2A.3'), resources produced by the economy must be devoted, in addition to consumption, investment, and research and development, to net purchases of emission permits. Equation (2A.6) states that a region's emissions may exceed the limit set in Kyoto if permits are bought, and vice versa in the case of sales of permits. Note that $p(t)$ is the price of a unit of tradable emission permits expressed in terms of the numeraire output price. Moreover, there is an additional policy variable to be considered in this case, which is net demand for permits *NIP*.

In terms of the possibility of emissions trading, the sequence whereby a Nash equilibrium is reached can be described as follows. Each region maximizes its utility subject to its individual resource and capital constraints, now including the Kyoto constraint, and the climate module for a given emission (that is, abatement) strategy of all the other players and a given price of permits $p(0)$ (in the first round this is set at an arbitrary level). When all regions have made their optimal choices, the overall net demand for permits is computed at the given price. If the sum of net demands in each period is approximately zero, a Nash equilibrium is obtained; otherwise the price is revised as a function of the market disequilibrium and each region's decision process starts again.

3. Do regional integration approaches hold lessons for climate change regime formation? The case of differentiated integration in Europe

Noriko Fujiwara and Christian Egenhofer

There are difficulties involved in characterizing as 'likely' a scenario of a global climate change regime in which either a top-down or a bottom-up approach dominates. A top-down approach envisages the formation of a global coalition at the outset. This scenario addresses a situation in which a global agreement on emission reductions is enforced. Profits that the coalition yields are distributed among participants through global or in some cases, sub-global agreements. A bottom-up approach reverses the process.

There is evidence of both top-down and bottom-up approaches. Following the US withdrawal from the Kyoto Protocol framework (top-down), entry into force of the protocol depended on the political will of Russia to ratify it. It is fair to suggest that it was the EU bilateral offer of a package including trade and human rights issues which eventually moved Russia, following Ukraine, to join in the Kyoto Protocol, which the EU has identified as its policy priority. The Asia-Pacific Partnership on Clean Development and Climate, which aims at closer coordination of a number of key countries grouping in the sphere of climate change, is another example.

Bottom-up approaches can not only be an important complement to the Kyoto Protocol negotiations but can also constitute the implementation stage of climate change politics. As the Kyoto Protocol entered into force and its framework remains at least until 2012, it is likely that the implementation of the treaty will rely to at least an extent on sub-global arrangements, where trade-offs can be settled more readily as issue linkages with trade, energy or development tend to be stronger. What we call 'sub-global' arrangements are often called regional agreements, principally in the economic and trade literature (see the Introduction, and Chapters 2 and 4 of this book) and throughout this book the terms are used interchangeably. However, so-called regional agreements

do not necessarily need to be 'regional', that is, defined by geographical proximity, as for example the G-77 bloc of countries demonstrates. Nevertheless, in many cases there is a regional dimension to sub-global arrangements as both the scope and the scale for issue linkage are the highest at the regional level as a result of policy linkages or, in many cases, trade flows.

The purpose of this chapter is to examine whether and under what conditions a specific form of a bottom-up approach, regionalization or European regional integration can be an important complement to top-down approaches to the creation of a global climate change regime. The chapter will briefly introduce different forms of regionalization so as to distinguish the specific European variant from other forms. It then moves on to present evidence of regionalization within the framework of European integration on the basis of recent changes in overall EU external relations with its neighbours and partners. This includes a sketch of existing institutional frameworks for cooperation with the EU for a number of targeted countries and regions. The concluding section will return to the original question of the merit of regionalization as a specific bottom-up approach for formation of a climate change regime.

3.1 THE SPECTRUM OF REGIONALIZATION

There is evidence of EU-sponsored bottom-up approaches, concerned with the ongoing process of integrating the environmental dimension into development cooperation and strengthening the sustainability dimension of EU external policies. There is notably a growing trend towards the integration of climate policies into economic and foreign policies, among others development cooperation and energy policy.[1]

The emphasis of policy integration increases the scope for settling trade-offs related to climate change in a broader framework (that is, issue linkages), for example by linking trade, economic cooperation, energy, security or human rights issues. The assumption is that a cluster of sub-global arrangements (that is, bottom-up approaches) can be designed to provide for an attractive package to settle trade-offs and conflicts of interest and thereby facilitate the ultimate goal of regime formation at the global level. This is one of the reasons for which we will consider the case of regionalization as one distinct form of bottom-up approach. The other reason is that the EU-specific form of bottom-up approach is distinctly regional and is often referred to as regionalization.

Regional arrangements can take different forms: bilateral (between countries; in this chapter between the EU and non-member states), intra-regional

(within the framework of already existing regional agreements) or inter-regional (between regional blocs).

At the same time, there are different models of regional (or 'sub-global') arrangements ranging from a loose tactical coalition building in international negotiations – for example, the UN Framework Convention on Climate Change (UNFCCC) or the World Trade Organization (WTO) – to a formalized long-term framework cemented by international agreements or treaty as is the case for the European Union. The spectrum and the different forms are described in Table 3.1.

Coalition building is the loosest form of regional or sub-global arrangements. It is especially small states that consider benefiting most from coalition building. The rationale for coalition building is that small states generally face disadvantages due to relatively high costs of negotiations coupled with low bargaining power. Forming a coalition generally enables small countries to reduce such costs by pooling their resources, while at the same time increasing their bargaining power (Schiff, 2002; Gupta, 2000). A good example of such a coalition motivated by cost efficiency is the Small Island Developing States (SIDS). On a larger scale, despite their self-acknowledgement of heterogeneity among developing countries in climate change negotiations and in EU-sponsored development cooperation respectively, the G-77 (131 countries) and the 78 Africa, Caribbean, Pacific (ACP) countries strategically continue their efforts to speak with one voice. The same can be said for trade negotiations since the start of the Doha round, where rapidly developing countries increasingly speak with one voice (see Chapter 4).

Coalitions can be either semi-permanent or *ad hoc*. The G-77 has developed a permanent institutional structure with the creation of Chapters in

Table 3.1 UNFCCC versus EU model of regionalization

Model	UNFCCC model	EU model
Framework	Policy coordination only (e.g. UNFCCC/Kyoto Protocol)	Regulatory approximation (e.g. EU treaties; accession agreements; pre-accession agreements)
Cooperation mode	*Ad hoc* coalitions (e.g. Umbrella group, CACAM, Environmental Integrity Group, etc.)	Institutionalized relations (e.g. Euro-Med Partnership; EU–ACP partnership; European Neighbourhood Policy, etc.)
Mobility	High (potentially multi-directional)	Low (one-directional towards deepening)

Rome, Vienna, Paris and Nairobi.[2] In contrast the Kyoto Protocol negotiations witnessed the emergence of several *ad hoc* coalitions such as the Umbrella Group (Australia, Canada, Iceland, Japan, New Zealand, Norway, Russia, Ukraine, the US), CACAM (Central Asia, Caucasus and Moldova), and the Environmental Integrity Group (Mexico, Republic of Korea and Switzerland) (Yamin and Depledge, 2004: 32–48; Bang et al., 2005; Blok et al., 2005).

Opposite to coalition building on the spectrum of regional or sub-global arrangements is the EU model based on institutionalized relations with its partners (see next section). What makes the EU model distinct from any other sub-global initiatives is EU member states' strong commitments to regional integration *per se*; that is, regional integration is an objective on its own. At its core this includes regulatory approximation (that is, to make national laws conform to EU law) for the areas that member states have identified for integration. All EU member states agree that matters of the integration of markets (that is, internal markets) should fall under EU-level governance and regulatory approximation.[3] An EEA (European Economic Area) member state is required to bring national legislation in line with EU legislation.[4] The requirement for EU and EEA member states goes far beyond policy coordination or coalition building. Regulatory approximation is not only an obligation for candidate countries to accede to the EU (Egenhofer et al., 2005) but also constitutes part of the conditionality attached to EU financial and technical assistance to non-candidates in its neighbourhood and to partners outside Europe. Hence, it is an integral part of the EU's relationship to its neighbours or associated countries.

There is a difference between the dynamics of climate change negotiations and regional economic integration. Generic 'regional' groupings that could form regional or sub-global arrangements (that is, in the context of EU regional integration) do not necessarily coincide with specific groupings which are active in climate change negotiations. Based on the UN tradition, parties to the FCCC have been organized into five regional groups[5] which provide access to the decision-making process[6] but are not usually used to present the substantive interests of parties. Groupings in climate change negotiations depend on more than regional configuration, such as on their natural resource endowments, vulnerability to the impacts of climate change, income levels and public perception. Geography may however matter in the implementation of adaptation measures, given the considerable variance in distributive impacts of global climate change across regions.

The likelihood of a mismatch between generic 'regional' groupings and negotiation groupings should not be underestimated. The mobility of countries across regional blocs is much higher than territorial borders

suggest. In particular, since US withdrawal from the Kyoto Protocol framework in 2001 the main groups formed in the run-up to the protocol negotiations have been further fragmented and realigned according to issue-specific interests rather than geographical proximity.[7] The high mobility in coalition building at climate change negotiations therefore requires careful examination on a case-by-case basis.

3.2 EVIDENCE FROM 'EUROPEAN INTEGRATION'

This section will first focus on the EU model of regionalization, then sketch recent policy initiatives and analyse the 'making' of regional groups as the EU's partners. The analysis will focus on the ways by which each regional group has developed bilateral ties with the EU in trade and regulatory approximation while forming various (sub-)regional groups with different degrees of integration in its own space.

3.2.1 From Bilateralism to Multilateralism

EU external relations with a third country are essentially bilateral. The EU model of regionalization has resulted in a dense network of predominantly bilateral channels (that is, 'EU-to-third country'[8]) with limited degrees of multilateral ('EU-to-countries') and (sub-)regional ('EU-to-region') mechanisms (Table 3.2).[9] This is to a large extent the result of recipient countries' preferences, but also due to the lack of effective regional integration within the regions concerned.

Based on the EU model of regionalization Table 3.2 represents three dimensions of EU external relations with third countries. It locates in each dimension examples of recent policy initiatives (agreements, institutions, mechanisms and issues) which build on existing EU initiatives and reflect EU competencies. Examples of both policy initiatives and regional groupings will be detailed in sections 3.2.2 and 3.2.3. The issues indicated in the table (that is, institutional arrangements, development cooperation, energy cooperation, trade with third countries and linking of Emissions Trading Schemes – ETSs) fall within the EU competence as agreed by its member states (see section 3.1). We exclusively focus on the policy areas of EU competence and on relevant EU legislation[10] so that we can concentrate our analysis on the different emphasis of an EU external relation on each of the three dimensions, depending on its partner.

The nature of an EU external relation can be vertical (that is, asymmetric in favour of the EU), horizontal (that is, on an equal footing defined by an agreement based on negotiated consensus) or a combination of these.

Table 3.2 Three dimensions of external relations in the EU model of regionalization

Dimensions of external relations	Bilateral Multilateral	(Sub-)Regional		
Nature of relations (vertical, horizontal, hybrid)*	Vertical e.g. EU to a CIS or ACP country or a southern Mediterranean partner	Hybrid: horizontal and vertical e.g. EU to EEA, EMP or ACP 1st step: horizontal 2nd step: vertical The creation of the horizontal link is their independent decision	Hybrid: horizontal and vertical e.g. EU to sub-regional Mediterranean groups or regional ACP groups. The horizontal link within the groups is a precondition or preference for their integration with EU	Horizontal e.g. Baltic or Arctic countries plus EU
Nature of contractual agreements	Formally reciprocal but essentially conditional, modelled on *acquis* (body of EU law) e.g. agreements with Switzerland; CIS Partnership and Cooperation Agreements; Mediterranean Association Agreements; ACP Economic Partnership Agreements (EPAs)	Formally reciprocal but essentially conditional e.g. agreements with European Economic Area (EEA); EU–ACP Partnership Agreement (Cotonou Agreement)	Conditional or preferential e.g. EPAs with 6 regional groups in ACP (West Africa, Central Africa, Eastern and Southern Africa, SADC, Caribbean, Pacific); Arab–Med Free Trade Agreement (Agadir Agreement), the Arab Maghreb Union, and the Mashreq group among Mediterranean partners	Cooperative e.g. Testing Ground Agreement for Flexible Mechanisms of the Kyoto Protocol (Baltic countries in the ND)

Table 3.2 (continued)

Dimensions of external relations	Bilateral Multilateral	(Sub-)Regional		
Institutions	Modelled on EU institutions head of states' summits, Councils, Joint Parliament Assemblies (e.g. CIS countries)	Modelled on EU institutions Summits, Councils, Committees, Joint Parliament Assemblies (e.g. EEA, EMP, ACP)		Generic e.g. high-level advisory body of experts for BALTREL
Mechanisms	action plans (e.g. ENP); dialogue (e.g. EU–Russia Energy Dialogue); technical assistance (e.g. TACIS, MEDA)	technical assistance e.g. MEDA		action plans (e.g. ND); work plans (e.g. BASREC)
Issues	e.g. institutional arrangements; trade; development; energy; climate change (emissions trading)	e.g. institutional arrangements; trade; development	e.g. trade; development	e.g. energy; trade

Notes:
ACP (Africa, Caribbean and Pacific); BALTREL (Baltic Ring Electricity Co-operation Committee); BASREC (Baltic Sea Region Energy Co-operation); CIS (Commonwealth of Independent States); EEA (European Economic Area); EMP (Euro–Mediterranean Partnership); ENP (European Neighbourhood Policy); ND (Northern Dimension); SADC (Southern African Development Community); TACIS (Technical Assistance for the Commonwealth of Independent States).
* Vertical – asymmetric in favour of EU; horizontal – on an equal footing defined by an agreement based on negotiated consensus.

Sources: http://europa.eu.int/comm/development/body/theme/cooperation/index_en.htm; Egenhofer et al. (2005); Vahl (2005); Emerson et al. (2002); Philippart (2003); Whitman (2001).

Whether it addresses a vertical, horizontal or hybrid relation, an agreement between the EU and its partner(s) can be largely regarded as contractual. Depending on the partner(s), the nature of a contractual agreement can be reciprocal, conditional, preferential and/or cooperative. In most cases, especially those involving vertical integration, agreements and institutions governing external relations are modelled on EU law (*acquis*) and EU institutions respectively. In contrast, agreements on linking of ETSs, in which partners are developed countries or transition economies, or the Baltic region's agreement for flexible mechanisms, are based on horizontal agreements with third countries and are therefore rather unrestrained from EU legal requirements.

EU external relations rely heavily on a dense web of bilateral agreements such as Mediterranean Association Agreements and Economic Partnership Agreements for Asia, Caribbean and Pacific (ACP) countries. Moreover the European Neighbourhood Policy (ENP) – the EU's strategy towards neighbouring countries without promise for membership – has a strong bilateral dimension through the process of formulating and agreeing on Action Plans (see section 3.2.2). Similarly, to link the EU ETS with equivalent schemes in other countries, the EU has set out preconditions for the eligibility of partners in EU law (see section 3.2.3). Therefore, linking of ETSs will be most likely go through a bilateral route.

In energy, due to limited competence the EU can only work with limited incentives to motivate partners to cooperate. Among them is the offer to its neighbours including major producers (for example Russia) and transit countries (for example Ukraine) to become part of the EU's liberalized internal energy market via a bilateral energy partnership and a new treaty or bilateral agreements aimed at the creation of a pan-European Energy Community respectively (see section 3.2.2). This is another form of bilateralism.

On the other hand Table 3.2 implies that despite the strong focus on bilateralism (EU-to-third country), it selectively encourages 'sub-regionalism' on a case-by-case basis. In particular the EU external approach to security of energy supply focuses on natural gas supplies from Russia to the EU via a limited number of transit countries. Natural gas transportation, with the exception of liquefied natural gas (LNG) that is transported by tankers, has an exclusive regional focus. So does EU security of supply. As the Northern Dimension area is endowed with rich energy resources such as gas and oil, energy is identified with one of the priority sectors in the implementation of the Northern Dimension Action Plan.[11] Within the area a sub-regional cooperation framework known as the Baltic Sea Region Energy Cooperation (BASREC) has been developed. Moreover, the Testing Ground Agreement for Flexible Mechanisms of the Kyoto Protocol was signed in

order to stimulate energy-sector climate change investment projects in the Baltic region (European Commission, 2005b: 15–16).[12]

In another strand of sub-regionalism, formation of a horizontal link is made in effect conditional or, if not conditional, preferential for further vertical integration with the EU. Examples include six regional groups of ACP countries (see section 3.2.3) and three sub-regional groups such as Agadir, Maghreb, and Mashreq in the Mediterranean (Emerson and Noutcheva, 2005) (see section 3.2.3).

In the EU model, sometimes sub-regionalism and multilateralism are used interchangeably: the EU negotiates with a sub-region or a group of countries. In this context sub-regionalism or multilateralism is compared with and can be seen as an alternative to bilateralism. Examples of a multilateral mechanism can be found in forms of trade or development cooperation such as the Euro-Mediterranean Partnership or the Cotonou Agreement (see sections 3.2.3). The Euro-Mediterranean Free Trade Area will be founded on a body of bilateral agreements complemented by multilateral mechanisms and a smaller number of sub-regional agreements (see section 3.2.3).

In theory some degree of differentiation can apply to all the channels – bilateralism, multilateralism and (sub-)regionalism – as an incentive for the willing and able to step up their efforts on further integration and to choose the levels of their integration. In practice, bilateralism can be viewed as a presumption of individualized ('tailor-made') and differentiated approaches while sub-regionalism can be better addressed in common and uniform approaches; that is, it is best applicable if a group of countries is relatively homogeneous in terms of size, economic development and language, as is the case for the countries of ex-Yugoslavia.

3.2.2 Review of EU Regionalization Approaches

Based on the general EU approach towards its neighbours and partner countries there have been a number of policy initiatives. The most important initiative is the European Neighbourhood Policy framework. Other areas include energy and development cooperation.

The wider European Neighbourhood Policy framework

The future of EU external relations with its neighbour and partner countries that do not foresee immediate prospects for accession to the Union – non-candidates are essentially Commonwealth of Independent States (CIS) countries – has been spelled out in a strategy paper on the European Neighbourhood Policy (ENP).[13] The objective of the ENP is to share and mutually reinforce for the non-EU neighbouring countries political

and economic benefits that arose from the accession of 2004 by eight Central and Eastern European countries to the EU. Thereby the ENP is designed to prevent the emergence of new divisions between the enlarged Union and its neighbours, and reinforce EU relations with these countries (European Commission, 2004a).

The ENP strongly emphasizes bilateralism and differentiation, which by definition reduces the rationale for small states' coalition building; reduction of (transaction) costs; and an increase in bargaining power. Bilateralism is clear from the structure of ENP: Action Plans are to be negotiated between the EU and a partner country on an individual and contractual basis (European Commission, 2004b). The second principal pillar of the EU neighbourhood strategy is differentiation together with progressive engagement. Progressive engagement in essence is a multi-speed approach to integration as envisaged in the EU–Mediterranean or the ACP partnership. This reflects the understanding that countries have different starting points with dissimilar levels of capacities such as the stage of development or reform. As a result, partnerships pursue diverse objectives with different rates of expected progress.

Energy cooperation

The European Neighbourhood Policy has been supplemented by a proposal on the development of energy policy and infrastructure for the enlarged Union, its neighbours and partners (European Commission, 2003d; European Commission, 2006a). This proposal aims at creating a broad cooperation framework between the EU and neighbours or partner countries on a variety of fields including energy efficiency, the creation of favourable conditions for renewables in the EU and its neighbourhood, and the need for increasing investments in infrastructure (Council of the EU, 2003b; Council of the EU, 2006). For the longer term this should open the way to regulatory approximation: a level playing field in terms of market opening and fair competition; reciprocity in environmental protection and safety; further harmonization of rules and technical standards; and progressive engagement of partner countries in the development of the EU internal market. Ultimately, partner countries could become part of the EU internal energy market on the basis of a sector-specific agreement based on the model of the European Economic Area (EEA) (Emerson et al., 2002) or the bilateral agreement with Switzerland (Vahl and Grolimund, 2006). For Russia, with which it earlier developed the so-called Energy Dialogue for a bilateral partnership (Fujiwara, 2003), the EU has tabled the so-called European Economic Space proposal (European Commission, 2002b; for the impact of the EU gas market on Russia see Finon and Locatelli, 2002), in fact a somewhat reduced version of the EEA

model. For other countries the EU offers a pan-European Energy Community,[14] largely reflecting the EU's own priorities (European Commission, 2006a: 16). Their realization would mean the *de facto* approximation of key legislation with EU law, which by definition would include the adoption and implementation of EU-style energy and related laws. In the case of Russia it would also mean the more or less full integration of Russia into the EU internal energy market with all its positive effects on energy security.

Development cooperation
The EU sets out an integrated strategy for addressing climate change and poverty reduction. The adverse effects of climate change will disproportionately affect low-income countries with economies predominantly based on natural resources and related economic sectors. Moreover they have the most vulnerable populations and the least adaptive capacity. The goal of the strategy has been to provide technical assistance to EU partner countries in the implementation of the UNFCCC and the Kyoto Protocol (European Commission, 2003a).[15] Through existing institutional frameworks the EU attempts to increase dialogue on climate change to identify country-specific needs better with the view to responding to them more effectively (European Commission, 2003a). Amongst others the priority on capacity development can be seen as a first step to 'progressive engagement' of these countries to the implementation of these treaties.

3.2.3 Do Regional Groupings Matter?

At the same time, EU approaches to its neighbours and partners need to take into account the realities of existing relations with different degrees of economic or political integration. The EU has therefore distinguished regional groupings between Russia, Ukraine and other CIS countries, the EU's Mediterranean partners and the EU's associated ACP countries.

Partnerships with Russia, Ukraine and other CIS countries
EU relations with Russia and Ukraine are characterized by asymmetry in terms of both their economic sizes and bilateral trade flows (Sutela, 2003: 124, 145).[16] The EU is a main trading partner of Russia and Ukraine but both play only a marginal role regarding imports with the notable exception of natural gas and oil imports from Russia. In 2004 the EU-15 imported 30.8 per cent of its crude oil from the former Soviet Union and 32.5 per cent of its gas from Russia (European Commission, 2006b). After the 2004 EU enlargement, the EU has replaced Russia as a main trading partner of Ukraine.

The EU has Partnership and Cooperation Agreements (PCAs) with Russia, Ukraine and Moldova. The backbone of these is a free trade area and regulatory approximation, however without firm timetables. The PCAs provide for a similar set of bilateral institutions for all three countries, which are based on the model of the principal EU institutions, that is, the Council of Ministers, the European Commission and the European Parliament (Council of the EU, 2003a; de Spiegeleire, 2003; Bordachev, 2003; Sutela, 2003). To support the transition process towards a market economy in each country and ultimately towards a free trade or a common economic space, the EU provides technical assistance in the form of TACIS (Technical Assistance for the Commonwealth of Independent States).

As to climate change, the TACIS programme can assist CIS countries to comply with their commitments to GHG emission reductions and benefit from mechanisms such as Joint Implementation (JI) and the Clean Development Mechanism (CDM) under the Kyoto Protocol. To date, the programme has financed projects which have been aimed at energy efficiency improvements in pilot regions and developed in the wider framework of the EU–Russia Energy Dialogue (European Commission, 2002a; European Commission, 2003c). It was also designed to ensure that countries taking on targets comply with the conditions set out in the Kyoto Protocol Article 17 to participate in international emissions trading (IET). It took some time for the Ukraine to realize the potential (financial) benefits that the Kyoto Protocol emissions trading framework offers. Capacity development can be seen as a first step to 'progressive engagement' of these countries to the implementation of these treaties.

In addition, JI credits are eligible as a compliance tool for the EU Emissions Trading Scheme for CO_2 (EU, 2003), that is, Russian, Ukrainian or other CIS credits can be sold into the EU market, provided they meet the requirements that are set out in the so-called Linking Directive (EU, 2004), which is an amendment of the EU Emissions Trading Directive (for example Egenhofer and Fujiwara, 2004). In theory it is possible that the EU Emissions Trading Scheme for CO_2 could be linked to similar domestic schemes of Russia or Ukraine should they come into existence, as both countries comply with the eligibility requirements spelt out by the Directive in Article 25, that is, ratification of the Kyoto Protocol (see also Egenhofer et al., 2005). While both the EU Emissions Trading Scheme for CO_2 and the Linking Directive have global reach and no particular CIS focus, in the discussions resulting in the Linking Directive, the effect on EU–Russia relations has come to the surface repeatedly (see Egenhofer and Fujiwara, 2004).

Potential supply and import of project-based credits from CIS (or CIS countries) are partly estimated from the margin for improvements in their

energy use. Transition countries such as Russia and Ukraine record considerably higher levels of energy intensity than other developed countries[17] as a result of dominance of the energy sector or energy-intensive industry in the economy (RF-BEA, 2002: 7; Chandler and Popov, 2003: 3; Chandler and Raptsun, 2001) as well as low productivity and efficiency in the sector (RF-BEA, 2002: 10). Due to lack of funds for modernization in the post-Soviet era, the energy sector in both countries remains inefficient with obsolete industrial infrastructure, substandard maintenance and outdated technology (Lee et al., 2001; Kotov, 2002: 103). This leaves ample opportunities for JI investors to earn a large quantity of credits at the lowest costs. Nonetheless, both Russia and Ukraine have failed to attract investments in JI projects because of institutional, funding and implementation problems (Evans et al., 1999; IES et al., 2001; Korppoo and Stern, 2002b; Diukanov and Lazi, 2003; Gassan-zade, 2003).

As an alternative to JI there is the potential for Russia and Ukraine to trade Assigned Amounts Units (AAUs) in IET.[18] Both Russia and Ukraine, unlike other CIS countries, have taken on quantified emissions reduction commitments under the Kyoto Protocol, which are set well above estimated emission levels (Chandler and Popov, 2003; Diukanov and Lazi, 2003; Chandler and Raptsun, 2001).

Consequently both Russia and Ukraine will have sizeable amounts of excess AAUs (Gassan-zade, 2003; Golub and Strukova, 2000) that may easily fill the deficit of other industrialized countries including the EU in meeting their Kyoto Protocol targets. Russia has one of the largest potentials for sale of excess AAUs. Ukraine has a very large amount of AAUs relative to the size of its economy (Evans et al., 1999). Without any need for investments in abatement measures these AAUs can be sold much cheaper than JI and CDM credits ('hot air'). The drawback is that IET starts only after 2008 and that Russia and Ukraine will first have to meet the eligibility criteria for participation.

A possible fast track for sales of their AAUs to the EU emissions trading market would be a Green Investment Scheme (GIS), which was originally proposed by Russia (Berdin et al., 2002). A GIS is to earmark revenues from sale of excess AAUs for projects that would yield further emission reductions. There are a number of benefits to be expected from the scheme: to generate additional environmental benefits from energy-related projects; to add international credibility to trading in excess AAUs; and to attract additional foreign investments in the energy sector (Golub and Strukova, 2000; Tangen et al., 2002; Korppoo and Stern, 2002a; Korppoo, 2003; Kokorin, 2003; Blyth, 2003). The expected benefits of the Russian GIS may apply to other transition countries including Ukraine (Diukanov and Lazi, 2003; Kokorin, 2003). Also, the GIS may contribute to the enhancement of

the EU strategy for security of energy supply by promoting modernization of infrastructures and technology in Russia.

With the entry into force of the Kyoto Protocol there is a renewed interest among Annex I parties in a GIS as a means of reducing their compliance costs as regards the Kyoto Protocol targets. Moreover, with a sizable potential for financial transfer, it can be also counted on as a tool in creating an incentive for host countries to undertake further emission reductions. Current bottlenecks are associated with institutional designs (for example eligibility, liability to transfer of AAUs), investment (for example transparency in an arrangement) and compliance (for example verification) (Kokorin, 2003).

The Euro-Mediterranean Partnership

Situated in immediate proximity to the EU, Southern Mediterranean countries grouped in the EU–Mediterranean partnership play an important role in security of energy supply to the EU. Algeria, Egypt and Libya are major producers and exporters of oil and gas to the EU. Morocco and Tunisia transit these resources.

For nearly a decade the EU and ten partners in the Southern Mediterranean[19] have developed the Euro–Mediterranean Partnership as the basis for further regional integration through the liberalization and promotion of trade on both bilateral and regional levels, with the ultimate objective being the creation of the so-called Euro–Med Free Trade Area by 2010.

On the bilateral level every country in the South Mediterranean has negotiated Association Agreements with the EU, which could constitute a foundation for trade liberalization and pave a way for regulatory approximation. On the regional level the Arab–Mediterranean Free Trade Agreement (the Agadir Agreement) foresees the creation of an integrated market between Egypt, Jordan, Morocco and Tunisia (for other initiatives see Emerson, 2004: 77–8).

The main principles guiding the Euro–Mediterranean Partnership include differentiation and progressive engagement. As a means to implement progressive engagement the 'multi-speed' approach allows member states to pursue common objectives at different speeds. The willing and able are free not only to move forward but also to integrate at the level of their preference, sub-regional or 'selective pan-regional' level (Philippart, 2003: 16). In the medium term, different levels of integration or 'sub-regional clubbing' are expected to coexist within the general EU–Mediterranean framework based on differences in both capacity and willingness (for example Philippart, 2003).

The Mediterranean partners can benefit from EU-sponsored regional programmes for environmental protection[20] but climate change does not

fall within their priority areas of action. This is partly explained by their relatively low levels of emissions (Egenhofer et al., 2005, Appendix 6). All the Southern Mediterranean countries are Non-Annex I parties and exempted from taking on quantified commitments to emission reductions.

The EU–ACP Partnership

The EU has formed a structured political and economic association with 77 developing countries in Africa, the Caribbean and the Pacific (ACP), principally former EU member states' colonies. The basis of this association is known as a special EU–ACP partnership agreement. Unlike other regional groups the importance of their role as the EU's trading partner remains marginal as the big majority are among the Least Developed Countries (LDCs).

The renewed Partnership Agreement with ACP countries known as the Cotonou Agreement envisages the creation of ACP free trade areas through a string of Economic Partnership Agreements (EPAs) (Holland, 2003; Karl, 2000). A principal element is differentiation including the multi-speed approach (Schiff, 2002), reflecting different levels of development, their resilience to competition or long-term strategies. This constitutes a significant shift of focus from previous ACP agreements (Holland, 2003; Arts, 2003). In practice this means that LDCs may be granted preferential treatment until they are ready for a gradual opening up to trade. In essence, countries remain on the same path but are allowed to advance at different speed.

The EU exhibits a preference for (sub-)regional negotiations with ACP countries. Six regional groups have emerged: West Africa, Central Africa, Eastern and Southern Africa, the Southern African Development Community (SADC),[21] the Caribbean and the Pacific. However, ACP countries resisted (sub-)regional negotiations because of possible divisive effects of EPAs. The regional groupings would discourage them to speak with one voice and weaken their position. On the other hand interstate negotiations between ACP states – detailed, possibly stretched over several years without guarantee of success (Holland, 2003) – will put small low-income countries at a disadvantage. Moreover, there are difficulties with legal and implementation issues due to inconsistency with existing frameworks. Some regions such as Africa will be divided by EPAs (for example Egypt, a non-member of ACP, has a separate agreement). There is also an overlap in memberships of existing regional organizations, especially in Southern and Eastern Africa (Gillson and Grimm, 2004; Arts, 2003).

The Cotonou Agreement regards environmental and natural resources as one of the important cross-cutting issues. However, it is not clear whether climate change is to be prioritized over other urgent issues such as

desertification and the management of water resources and tropical forests. Most ACP countries share general concerns with adaptation to the impacts of climate change, yet they face significantly different problems. For instance, Africa, especially the least developed and land-locked countries, will be more affected by drought and desertification while small island ACP countries will be particularly vulnerable to coastal storms and tidal waves. The Agreement takes account of these particular conditions (see Article 32, http://ec.europa.eu/development/body/cotonou/pdf/agr01_en.pdf). More recently, there have been signs that more than 40 LDCs, many of which are part of the ACP group, have become increasingly active in the climate change negotiations. Their common concerns are represented by the LDC Expert Group which is formally recognized in climate change negotiations (IISD, 2005: 6; Yamin and Depledge, 2004: 39–40).

3.3 SOME LESSONS FROM THE EU MODEL OF REGIONALIZATION

The EU model of regionalization has been based on three principles: (sub-) regionalism, differentiation and issue linkage. They have been essential to make the EU model work.

3.3.1 The Limits of (Sub-)Regionalism

The first lesson learnt from the European experience is the importance of a balance between differentiation between partners and the attempt to create (sub-)regional cooperation clubs. The principles of differentiation and progressive engagement allow for differentiated time-frames for achieving the set goal. Nonetheless countries at similar starting points are generally grouped together regardless of geographical proximity. On the other hand (sub-)regionalism has remained controversial. For example, ACP countries were initially opposed to regional negotiations. Some were thought to be worse off in regional negotiations than in bilateral talks, if the grouping proves to be very heterogeneous in the levels of capacities such as the stage of development or reform (Holland, 2003; Gillson and Grimm, 2004). At worst 'forced grouping' could work against voluntary cooperation among small states and discourage them to speak with one voice, their main negotiation strength (Arts, 2003).

The European Neighbourhood Policy confirms the EU preference for differentiation over (sub-)regionalism but the Strategy Paper is ambiguous as the two principles could prove to be conflicting (European Commission, 2004a: 20). While the paper notes the need of a more effective political

dialogue (European Commission, 2004a: 13), it also stresses the importance of extending such dialogue to regional cooperation issues, taking into account each country's own preference.

We should expect the role of (sub-)regionalism to be less relevant to international negotiations on climate change where groupings depend on more than regional configurations and are subject to high mobility. More importantly, asymmetry of bilateral relations between the EU and a partner country does not necessarily translate into the structure of international negotiations on climate change within the UN framework.

3.3.2 Effectiveness of Differentiation and Progressive Engagement

The second lesson learnt from the European experience was the effectiveness of differentiation and progressive engagement, which has proven to be an effective tool to set commitments in a flexible way on a case-by-case basis. These principles have been institutionalized in the European Neighbourhood Policy (ENP), the Euro-Mediterranean Partnership and the EU-ACP Partnership.

The principle of differentiation and progressive engagement is particularly relevant to the ongoing discussion of the post-2012 framework for international negotiations on climate change. In the run-up to the Kyoto Protocol negotiations there was a proposal for the concept of 'graduation' of developing countries from the Non-Annex I status according to levels of development – a concept equivalent to 'accession' or 'Europeanization' through 'progressive engagement' – by taking on quantified commitments for GHG emission reductions[22] (IISD, 1997; for a conceptual framework see literature on the 'multi-stage approach', for example Torvanger et al., 2005). In the UNFCCC negotiation context, Non-Annex I parties, that is, developing countries, have firmly resisted any proposals for their own 'graduation' or 'voluntary commitments'.[23] This has undermined the willingness of a small number of Non-Annex I parties to take on commitments motivated by the desire of participating in IET. These countries have encountered strong objections from some influential developing countries, which feared a precedent being set (IISD, 1997; Aslam, 2001: Depledge, 2002; Egenhofer and Fujiwara, 2003; for the recent interest of Belarus see IISD, 2005: 15; Depledge and Grubb, 2006). It is important to note that the climate change 'heavyweights' including India, China and Brazil are all outside EU partnerships.[24] This implies lack of strong disciplinary peer pressures upon breaking ranks among ACP countries.

Table 3.3 illustrates that there is a certain parallel between the UNFCCC/Kyoto Protocol framework and the EU model with regard to differentiation and progressive engagement. Both the UN model and the

Table 3.3 UNFCCC and EU differentiation and progressive engagement models (overview)

	Differentiation	Objective	Concept	Meaning
UNFCCC	Annex I; Non-Annex I	GHG reduction	Graduation to Annex I	Ability to accept hard targets based on graduation indices (measurable)
EU membership	Member; Candidates	Fulfil EU Treaty objectives* inside Europe	From pre-accession to accession	Overcoming mainly legal threshold: transposition and implementation of EU laws, institutions, budgets (measurable)
EU partnership	Member; Partner	Fulfil EU Treaty objectives*	'Europeanization'**	Adoption of basic EU values and norms based in indices (partly measurable)

Notes:
* peace, stability integration in Europe; human rights and democracy; market economy and trade liberalization.
** exporting European norms (see *).

Sources: on 'graduation' indices, Torvanger et al. (2005), Michaelowa et al. (2004), Green and Smith (2002).

EU model assume a country's move from one to another category at certain thresholds ('graduation', 'accession' or 'Europeanization'). While the former has received a number of proposals for creation of a performance-oriented and measurable index, the latter relies on normative and legally fixed thresholds. Hence, it would not be so straightforward to apply EU notions of differentiation and progressive engagement to international climate change negotiations.

3.3.3 The Merits of Issue Linkages

Issue linkage as a negotiation tool has both merits and demerits. Linking negotiation tracks, which requires sequential bargaining leading to a package deal, is more complicated than running single tracks in parallel (Pew Center, 2005). Another demerit would be possible transaction costs if a new negotiation platform has to be created. It appears that the EU case turned these disadvantages into advantages: a package deal is not only favoured but appears to be routinized, and there is no shortage of an existing framework for linking more than one track.

Therefore another lesson from the European experience is the effective use of issue linkages based on EU members' commitments to the ideal of regional integration *per se* and candidates' obligations to make their regulations conform to EU law (that is, 'regulatory approximation'). With its neighbours and partners the EU is prepared to enter into contractual relations or at least long-term stable relations, which are conditional upon their progress in commitments to regulatory approximation. The EU maintains this position firmly in the European Neighbourhood Policy (ENP), which promotes development of contractual links with a partner country based on 'mutual' commitments to shared values. The structure of EU external relations can help to broaden the possibilities for issue linkage.

Issue linkage can be facilitated by not only regulatory approximation but also by policy integration. Some experiences from the EU practice of conditionality for the purposes of environmental integrity (for the TACIS case, European Commission, 2003b) could be useful in widening the scope for a package of settling different interests and working out issue linkages. Since environmental integrity is also central to the selection of CDM projects by the Executive Board, hosting countries would be more willing to accept such a requirement from the EU and, more interestingly, might find EU-sponsored programmes useful to practice 'learning by doing'.

It is clear however that the best that we can expect from international cooperation would be policy coordination, not regulatory approximation or commitments to shared values. The entry and exit are relatively easier in international treaties than in the contractual and institutionalized relations

that the EU has developed with its neighbours in establishing region-wide communities. Although issue linkage is still possible under the package of policy areas or approaches such as trade, investment and technology (Carraro and Buchner, 2003; Blok et al., 2005: 114–15; Philibert, 2005), the scope of issue linkages is more limited in the UNFCCC framework.

3.4 CONCLUSIONS

The main contribution of this study to discussions on the future shape of a global climate change regime is that bottom-up approaches including various forms of regional and non-regional cooperation can work and support the existing institutional framework built in a top-down manner. But at the same time, their potential contribution needs to be assessed on a case-by-case basis. Finally, from the EU experience it appears that regional integration may have the biggest impact regarding implementation and may be somewhat less important *vis-à-vis* negotiations.

The analysis of the EU's relations with its neighbours has demonstrated the dominance of bilateralism and differentiation, principally based on EU needs and preferences. Strategic issues such as security of energy supply tend to be discussed and settled by bilateral negotiations. Generally, it appears difficult at best to aim for a set of common objectives for all countries in a region. EU approaches are likely to remain tailor-made and differentiated with some adjustments on a case-by-case basis. Sub-global arrangements such as PCAs should therefore be used to widen the scope for possible trade-offs and facilitate issue linkages with climate change.

In contrast it would be possible and even effective to agree on objectives of a specific and/or technical nature such as energy efficiency improvements, and differentiate requirements for meeting these objectives. At the same time, with specific objectives set in place, it would be easier to arrange multilateral and (sub-)regional mechanisms (for example action plans, technical assistance) that can support bilateral channels (for example dialogue). Yet the basis of the relationship would remain bilateral. Specific policy objectives aimed at trade liberalization can lead to differentiation of commitments and be realized through various channels and mechanisms (for example the MEDA programme[25] under the Euro-Med Partnership).

EU experiences in differentiation of commitments as such can be valuable in the next round of climate change negotiations. In contrast, EU experiences on (sub-)regionalism are likely to matter less to climate change negotiations, which are essentially multilateral and to a less extent bilateral. Although issue linkages are still possible within the UN framework, the

scope for trade-offs is significantly narrower than for EU integration approaches. The best that we can expect from international negotiations would be policy coordination, not regulatory approximation. There are limits on the relevance of the EU model of regionalization and the principles governing EU external relations to international negotiations.

NOTES

1. Development cooperation has been included in a process aiming at the concrete integration of environmental dimensions into all EU policy areas for the promotion of sustainable development (the 'Cardiff Process') (European Commission, 2003a). Moreover the European Commission (2005a) has proposed 'stronger co-operation' on climate change with other countries and has singled out the European Neighbourhood Policy as a primary focus (p. 10). Furthermore the 2006 Green Paper (European Commission, 2006a) has established a firm link between energy security and climate change. It has also identified energy as one of the priorities for development cooperation (European Commission, 2006a: 17). This has firmly established the climate change dimension in these partnerships.
2. www.g77.org/
3. In contrast, other areas such as foreign and defence policy and traditional police and judicial areas should remain subject to policy coordination, hence a far lower level of integration, which does not necessarily include regulatory approximation. The different EU treaties distinguish pillar 1, covering economic integration, subject to largely supranational (that is, EU with majority voting) governance and regulatory approximation, and pillar 2 on security and defence measures, which is largely intergovernmental and based on unanimity with no or limited approximation. Pillar 3, covering police and judicial matters, is somewhere in between. See Pelkmans (2006) and Wallace et al. (2005).
4. This includes among others all domestic legislation in domestic policies and measures. For Norway's EEA membership see Emerson (2002). Switzerland, closely associated with the EU in an EEA-type agreement, has similar obligations to Norway (Vahl and Grolimund, 2006).
5. The five regional groups are Africa, Asia, Eastern Europe, Latin America and the Caribbean (GRULAC) and the Western Europe and Others Group (WEOG). http://unfccc.int/parties_and_observers/parties/negotiating_groups/items/2714.php.
6. The regional groups are the basis of nominating candidates for election in the COP Bureau. Each of the five regional groups is represented by two members and an additional post represents Small Island Developing States (SIDS). For details see Yamin and Depledge (2004: 409–15). The Bureau composition turned out to be one of the models on which the Compliance Committee of the Kyoto Protocol and in particular the Enforcement Branch was based. The other base was UNFCCC groupings of Annex I and Non-Annex I parties. The final membership of the Enforcement Branch consists of two from Annex I, two from Non-Annex I, one each from five regional groups and one from SIDS (Ulfstein and Weksman, 2005).
7. At the 11th Conference of Parties to UNFCCC (COP 11) and the 1st Meeting of Parties to the Kyoto Protocol (MOP 1) there was no longer a major effort for coalition building among Annex I parties other than individual national or organizational positioning. While the G-77 and China remain influential as a united voice, they exhibit the complexity and heterogeneity of their interests at issue-specific discussions (Wittneben et al., 2005b; Ott et al., 2004): the Alliance of Small Island States (AOSIS), the Least Developed Countries (LDC), the Organization of Petroleum Exporting Countries (OPEC) including Saudi Arabia, large populous countries such as Brazil, China, India, and others. For the role of OPEC in the G-77 see Chatham House (2005) and Dessai

(2004). For COP 11 and COP/MOP 1 see Depledge and Grubb (2006), Müller (2006), Wittneben et al. (2005b), IISD (2005). For actor groups and their positions or strategies, see Wittneben et al. (2005a), Bang et al. (2005), Ott et al. (2004), Blok et al. (2005), Egenhofer and Fujiwara (2003).

8. A 'third country' is best understood in EU jargon as describing non-EU member states that are not part of the European Neighbourhood Policy or other frameworks based on regulatory approximation.
9. For instance the Technical Assistance programme for the CIS (Commonwealth of Independent States) countries (TACIS) targeting Russia, Ukraine, Belarus and Moldova allocated only 18.1 per cent of total funds to multi-country programmes from 2000 to 2003 while the MEDA programme for the Mediterranean Region grouped in the so-called EU–Mediterranean partnership process set aside 24.75 per cent for regional programmes during the same period. The rest of each funding was spent on bilateral programmes (European Commission, 2004a: 30).
10. As Table 3.2 is developed on extension of the EU model, here we do not consider UN-based international agreements or the EU competence to negotiate for such treaties. The scope of analysis is limited to EU-based international agreements, institutional arrangements or legislations.
11. The Northern Dimension concept covers a geographical area stretching from the Arctic and sub-Arctic to the southern shores of the Baltic, and from north-west Russia in the east to Iceland and Greenland in the west (European Commission, 2005b).
12. The membership of the BASREC includes Denmark, Poland, Germany, Estonia, Latvia, Lithuania, Russia, Finland, Sweden, Norway and Iceland. The European Commission is represented by DG Energy and Transport (European Commission, 2005b).
13. The countries covered in the strategy include Belarus, Moldova, Ukraine, Russia, Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Syria and Tunisia. Libya has an observer status in the Euro-Med Partnership but no contractual relations. The European Commission recommends future inclusion of Armenia, Azerbaijan and Georgia (European Commission, 2004a).
14. This pan-European Energy Community would encompass the vast geographical space stretching from Turkey, Ukraine, the Caspian and (southern) Mediterranean countries including Algeria, and Norway (European Commission, 2006a: 16).
15. The partner countries include the Africa, Caribbean and Pacific, Asia and Latin America, (southern) Mediterranean, the Western Balkan and CIS countries. The strategy does not cover Croatia, Russia and Ukraine which have emission targets under the Kyoto Protocol (European Commission, 2003a).
16. For details, see: http://europa.eu.int/comm/trade/issues/bilateral/countries/russia/index_en.htm, http://europa.eu.int/comm/trade/issues/bilateral/countries/ukraine/index_en. htm.
17. Russia's energy intensity in 2003 was more than ten times that of the EU-15 and nearly 20 times that of Japan: Russia 2399 toe/Meuro; EU-15 214 toe/Meuro; Japan 122 toe/Meuro (European Commission, 2006b).
18. In the first half of 2005 reported volumes for JI/AAU were 5.3Mt compared with EU ETS at 75.8Mt and CDM at 24.9Mt (Hasselknippe et al., 2005). As of April 2005 transition economies rank fourth at 6 per cent of emission sales, trailing after Asia at 45 per cent, Latin America at 35 per cent, and OECD countries including New Zealand at 14 per cent (Lecocq and Capoor, 2005). While concentration of HFC23 destruction projects – few in number but very large in volume of emission reductions – in Asia and Latin America has been pointed out (Lecocq and Capoor, 2005; Ellis and Levina, 2005), the success of Bulgaria and Romania in the top five of emission reductions (Lecocq and Capoor, 2005) means that the current regime is not necessarily biased against transition economies.
19. The ten Southern Mediterranean partners are Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Palestinian Authority, Syria, Tunisia and Turkey. Libya has observer status.
20. These programmes include the Short and Medium-term Priority Environmental Action Programme (SMAP) as well as the LIFE-Third countries programme. The former targets at the Mediterranean countries while the latter supports countries in the (southern) Mediterranean, the Western Balkans and Russia.

21. The Southern African Development Community is made up of Angola, Botswana, Lesotho, Mozambique, Namibia, Swaziland and Tanzania. South Africa participates as an observer.
22. At the COP 3 New Zealand called for 'progressive engagement' according to relative levels of development and exemptions for LDCs (IISD, 1997).
23. The issue reappeared at COP 11 and COP/MOP 1 in 2005. Russia raised the issue in relation to the post-2012 framework, which resulted in overnight negotiations on the final day (IISD, 2005: 14; Depledge and Grubb, 2006).
24. South Africa will be the only exception.
25. The MEDA is the principal financial instrument of the EU for the implementation of the Euro–Mediterranean Partnership. The programme offers technical and financial support measures to accompany the reform of economic and social structures in the Mediterranean partners. See http://ec.europa.eu/comm/external_relations/euromed/meda.htm.

REFERENCES

Arts, K. (2003), 'ACP-EU relations in a new area: the Cotonou Agreement', *Common Market Law Review*, **40**, 95–116.

Aslam, M.A. (2001), 'International greenhouse gas emissions trading and issues related to voluntary participation by developing countries', in M.A. Aslam, J. Cozijnsen, S. Morozova, M. Stuart, R.B. Stewart and P. Sands (eds), *Greenhouse Gas Market Perspectives: Trade and Investment Implications of the Climate Change Regime: Recent Research on Institutional and Economic Aspects of Carbon Trading*, New York and Geneva: United Nations.

Bang, G., G. Heggelund and J. Vevatne (2005), 'Shifting strategies in the global climate negotiations: a strategic cooperation project, alternatives to the Kyoto Protocol', Fridtjof Nansen Institute, November.

Berdin, V., A. Moe, K. Tangen and O. Pluzhnikov (2002), 'GIS: starting point and main challenges', in K. Tangen, A. Korppoo, V. Berdin, T. Sugiyama, C. Egenhofer, J. Drexhage, O. Pluzhnikov, M. Grubb, T. Legge, A. Moe, J. Stern and K. Yamaguchi, *A Russian Green Investment Scheme: Securing Environmental Benefits from International Trading*, Climate Strategies.

Blok, K., N. Höhne, A. Torvanger and R. Janzic (2005), 'Towards a post-2012 climate change regime', final report to the European Commission, June.

Blyth, W. (2003), 'Green Investment Schemes: options and issues', OECD and IEA, COM/ENV/EPOC/IEA/SLT(2003)9.

Bordachev, T.V. (2003), 'Strategy and strategies', in A. Moshes (ed.), *Rethinking the Perspective Strategies of Russia and the European Union*, Special FIIA-Carnegie Moscow Center Report, Carnegie Moscow Center and the Finnish Institute of International Affairs.

Carraro, C. and B. Buchner (2003), 'Issue linkage and climate regimes', Final report prepared for the Environmental Studies Group, ESRI, Cabinet Office, Government of Japan, International Forum for Environmental Issues, Tokyo, 27 February – 1 March.

Chandler, W. and I. Popov (2003), 'Russia's decisive role in the Kyoto Protocol, Pacific Northwest National Laboratory', May, PNNL-14302.

Chandler, W. and M. Raptsun (2001), 'Modeling and analysis of greenhouse gases emissions in Ukraine: selecting and adapting the ENPEP Program to Ukrainian

conditions and test modeling', Pacific Northwest National Laboratory and Agency for Rational Energy Use and Ecology, Ukraine, November, PNNL-13874.
Chatham House (2005), 'OPEC and climate change challenges and opportunities: report', November.
Council of the European Union (2003a), Twelfth EU–Russia Summit, Rome, 6 November, 13990/03 (Presse 313), http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressdata/en/er/77845.pdf.
Council of the European Union (2003b), 2554th Council meeting, transport, telecommunications and energy, Brussels, 15 December, 15998/03 (Presse 370), http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressdata/en/trans/78436.pdf.
Council of the European Union (2006), Brussels European Council 23/24 March 2006: Presidency Conclusions (Brussels, 18 May; 7775/106), http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/89013.pdf.
Depledge, J. (2002), 'Continuing Kyoto: extending absolute emission caps to developing countries', in K. Baumert, O. Bianchard, S. Llosa, J.F. Perkaus (eds), *Building on the Kyoto Protocol: Options for Protecting the Climate.* World Resources Institute.
Depledge, J. and M. Grubb (2006), 'COP/MOP-1 and COP-11: a breakthrough for the climate change regime?' *Climate Policy*, **5**, 553–60.
de Spiegeleire, S. (2003), 'Recoupling Russia to Europe: staying the course', *International Spectator*, **3**, 79–97.
Dessai, S. (2004), 'An analysis of the role of OPEC as a G-77 member at the UNFCCC', Report for WWF.
Diukanov, V. and G. Lazi (eds) (2003), 'The national strategy of Ukraine for Joint Implementation and emissions trading', Program of National CDM/JI Strategy Studies, NSS Program, the Swiss Government, the Government of Ukraine, and the World Bank.
Egenhofer, C. and N. Fujiwara (2003), 'The emerging climate change regime: the UNFCCC, the Kyoto Protocol forever, Kyoto modified . . . or yet something else?' Final report of CEPS study 1 prepared for the Environmental Studies Group, ESRI, Cabinet Office, Government of Japan, International Forum for Environmental Issues, Tokyo, 27 February – 1 March.
Egenhofer, C. and N. Fujiwara (2004), 'The completion of the EU emissions trading scheme and the emerging global climate regime', CEPS Task Force Report No. 49, February.
Egenhofer, C., N. Fujiwara and D. Kernohan (2005), 'Bottom-up approaches in the formation of a global climate change regime: the potential of regional bubbles and emission markets', Final report prepared for Environmental Studies Group, Economic and Social Research Institute, Cabinet Office, Government of Japan, International Forum for Environmental Issues, March.
Ellis, J. and E. Levina (2005), 'The developing CDM market', OECD/IEA, November.
Emerson, M. (2004), 'The Wider Europe matrix', Brussels, Centre for European Policy Studies.
Emerson, M. and G. Noutcheva (2005), 'From Barcelona process to neighbourhood policy', CEPS Working Document No. 220, March.
Emerson, M., M. Vahl and S. Woolcock (2002), 'Navigating by the Stars: Norway, the European Economic Area and the European Union', Centre for European Policy Studies.

European Commission (2002a), 'Energy dialogue with Russia: update on progress', Commission staff working paper, SEC (2002)1272, 20 November.
European Commission (2002b), 'Report of the High-Level Group on the Common European Economic Space', November.
European Commission (2003a), 'Climate change in the context of development cooperation', Communication from the Commission to the Council and the European Parliament, COM(2003) 85 final, 11 March.
European Commission (2003b), 'TACIS regional cooperation: strategy paper and indicative programme 2004–2006', 11 April.
European Commission (2003c), 'Energy dialogue with Russia: update on progress since the November 2002 EU–Russia Summit', Commission staff working paper, SEC(2003) 473, 15 April.
European Commission (2003d), 'Communication from the Commission to the Council and the European Parliament, on the development of energy policy for the enlarged European Union, its neighbours and partner countries', 13 May, COM(2003) 262 final.
European Commission (2004a), Communication from the Commission, 'European Neighbourhood Policy, Strategy Paper', COM(2004) 373 final, 12 May.
European Commission (2004b), 'Communication from the Commission to the Council on the Commission proposals for action plans under the European Neighbourhood Policy (ENP)', COM(2004) 795 final, 9 December.
European Commission (2005a), 'Winning the battle against global climate change', Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, COM(2005) 35 final.
European Commission (2005b), '2004 annual progress report on the implementation of the Northern Dimension Action Plan', Commission Staff Working Document, SEC(2005) 688, 20 May.
European Commission (2006a), 'Green Paper: A European strategy for sustainable, competitive and secure energy, COM(2006) 105 final, 8 March.
European Commission (2006b), 'EU energy and transport in figures 2005', in cooperation with Eurostat.
European Union (2003), 'Directive 2003/97/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emissions allowance trading within the Community and amending Council Directive 96/61/EC', *Official Journal of the European Union*, L 275, 32–46, 25 October.
European Union (2004), 'Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/97/EC establishing a scheme for greenhouse gas allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms', *Official Journal of the European Union*, L 338, 18–23, 13 November.
Evans, M., S. Legro and I. Popov (1999), 'The climate for Joint Implementation: case studies from Russia, Ukraine and Poland', Pacific Northwest National Laboratory.
Finon, D. and C. Locatelli (2002), 'The liberalization of the European gas market and its consequences for Russia', Institut d'Economie et de Politique de l'Energie.
Fujiwara, N. (2003), 'The EU–Russia energy dialogue: where is it leading to?' *OGEL*, **1** (5) (December), 1–5.
Gassan-zade, O. (2003), 'Economies in transition: at the crossroads of development', International Institute for Sustainable Development, Climate Change Knowledge Network.

Gillson, I. and S. Grimm (2004), 'EU trade partnerships with developing countries', ODI European Development Cooperation to 2010, April.
Golub, A. and E. Strukova (2000), 'Economies in transition: pathways for sustainable economic development and climate protection', Environmental Defense, November.
Green, D. and K.R. Smith (2002), 'The implications of graduation: why developing nations will never produce more greenhouse gases than developed countries', *Journal of Energy and Development*, **28** (1), 15–40.
Gupta, J. (2000), 'On behalf of my delegation . . .: a survival guide for developing country climate negotiators', Center for Sustainable Development in the Americas and the International Institute for Sustainable Development.
Hasselknippe, H., J. Buen, M. Nordseth, O. Gazzan-zade and A. Eik (2005), 'The carbon market in 2005: an overview of volumes and financial size', in R. Dornau (ed.), *Greenhouse Gas Market 2005: The rubber hits the road*, Geneva: International Emissions Trading Association.
Holland, M. (2003), '20/20 vision? The EU's Cotonou partnership agreement', *Brown Journal of World Affairs*, **9**, 2.
Institute of Energy Strategy, Institute of Global Problems of Energy Efficiency and Ecology, and Fridtjof Nansen Institute (IES, IGPEEE, FNI) (2001), The approval system for Joint Implementation projects in Russia – criteria and organization', FNI Report 6/2001, June.
International Institute for Sustainable Development (IISD) (1997), 'Report of the third Conference of the Parties to the United Nations Framework Convention on Climate Change: 1–11 December 1997', *Earth Negotiations Bulletin*, **12** (76) (13 December), 1–16.
International Institute for Sustainable Development (IISD) (2005), 'Summary of the eleventh Conference of the Parties to the UN Framework Convention on Climate Change and first Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol: 28 November – 10 December 2005', *Earth Negotiations Bulletin*, **12** (291) (12 December), 1–20.
Karl, K. (2000), 'From Georgetown to Cotonou: the ACP Group faces up to new challenges', *Courier*, September, 20–23.
Kokorin, A. (2003), 'Green Investment Scheme as a way of promoting environmentally-sound cooperation among Russia, Canada, Japan and other nations under the Kyoto Protocol', International Institute for Sustainable Development, Climate Change Knowledge Network.
Korppoo, A. (2003), 'Forging alliance with Russia: the example of a Green Investment Scheme', *Climate Policy*, **3**, 67–76.
Korppoo, A. and J. Stern (2002a), 'Contribution of a GIS to the Russian energy sector', in K. Tangen et al., *A Russian Green Investment Scheme: Securing Environmental Benefits from International Emissions Trading*, Climate Strategies.
Korppoo, A. and J. Stern (2002b), 'Institutional barriers and lessons of previous agreements for the GIS in Russia', in K. Tangen et al., *A Russian Green Investment Scheme: Securing Environmental Benefits from International Emissions Trading*, Climate Strategies.
Kotov, V. (2002), 'Transition in Russia: implications on climate policy', in S. Yoon (ed.), *Policy design of Climate Change: Collaboration in Northern Asia*, Institute of Global Environmental Strategies, Asia Pacific Network.
Lecocq, F. and K. Capoor (2005), 'State and trends of the carbon market 2005',

World Bank and International Emissions Trading Association, Washington, DC, 9 May.
Lee, H., P. Vorobyov and C. Breznik (2001), 'Entering Russia's power sector: challenges in creating a credible carbon trading system', Environment and Natural Resources Program, Belfer Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University.
Michaelowa, A., S. Butzengeiger and M. Jung (2004), 'Graduation and deepening: an ambitious post-2012 climate policy scenario', paper submitted to the EU post-2012 climate policy dialogue, October.
Müller, B. (2006), 'Montreal 2005: what happened, and what it means', Oxford Institute for Energy Studies, EV 35, February.
Ott, H.E., H. Winkler, B. Brouns, S. Kartha, M.J. Mace, S. Huq, Y. Kameyama, A.P. Sari, J. Pan, Y. Souona, P.M. Bhandari, A. Kassenberg, E.L. La Rovere and A.A. Rahman (2004), 'South–North dialogue on equity in the greenhouse: a proposal for an adequate and equitable global climate agreement', report to the Federal Ministry for Economic Cooperation and Development, Germany, May.
Pelkmans, J. (2006), *European Integration*, 3rd edn, Zug, Switzerland: Pearson Education Schweiz.
Pew Center (2005), 'International climate efforts beyond 2012', report of the climate dialogue at Pocantico, 15 November.
Philibert, C. (2005), 'Climate mitigation: integrating approaches for future international cooperation', OECD, 14 November.
Philippart, E. (2003). 'The Euro-Mediterranean Partnership: unique features, first results and future challenges', CEPS Working Papers, 10, April.
Russian Federation, Bureau of Economic Analysis (RF-BEA) (2002), 'Development of greenhouse gas emission trading mechanisms', Moscow.
Schiff, M. (2002), 'Regional integration and development in small states', Policy Research Working Papers (World Bank), 2797, March.
Sutela, P. (2003), *Russia and Europe: Some Economic Aspects*, Moscow: Carnegie Moscow Center.
Tangen, K., A. Korppoo, V. Berdin, T. Sugiyama, C. Egenhofer, J. Drexhage, O. Pluzhnikov, M. Grubb, T. Legge, A. Moe, J. Stern and K. Yamaguchi (2002), '*A Russian Green Investment Scheme: Securing Environmental Benefits from International Emissions Trading*', Climate Strategies.
Torvanger, A., G. Bang, H.H. Kolshus and J. Vevatne (2005), 'Broadening the climate regime: design and feasibility of multi-stage climate agreement', CICERO Report, May.
Ulfstein, G. and J. Weksman (2005), 'The Kyoto compliance system: towards hard enforcement', in O.S. Stokke, J. Hovi and G. Ulfstein (eds), *Implementing the Climate Regime*, London: Earthscan.
Vahl, M. (2005), 'Models for the European Neighbourhood Policy: the European Economic Area and the Northern Dimension', CEPS Working Document, No. 218, February.
Vahl, M. and N. Grolimund (2006), *Integration without Membership: Switzerland's Bilateral Agreement with the EU*, CEPS Paperback Books, Brussels: Centre for European Policy Studies (CEPS).
Wallace, H., W. Wallace and M.A. Pollack (eds) (2005), *Policy-making in the European Union*, 5th edn, Oxford: Oxford University Press.
Whitman, R.G. (2001), 'Five years of the EU's Euro-Mediterranean Partnership:

progress without partnership?' paper prepared for the ISA (International Studies Association) annual conference, Chicago, IL, 20–24 February.
Wittneben, B., A. Haxeltine, B. Kjellen, J. Köhler, J. Turnpenny and R. Warren (2005a), 'A framework for assessing the political economy of post-2012 global climate regime', Tyndall Centre for Climate Change Research, Working Paper, 80, August.
Wittneben, B., W. Sterk, H.E. Ott and B. Brouns (2005b), 'In from the cold: the climate conference in Montreal breathes new life into the Kyoto Protocol', Wuppertal Institute for Climate, Environment and Energy, December.
Yamin, F. and J. Depledge (2004), *The International Climate Change Regime: A Guide to Rules, Institutions and Procedures*, Cambridge: Cambridge University Press.

4. Trade, the environment and climate change: multilateral versus regional agreements

David Kernohan and Enrica De Cian

Trade liberalization and climate change share common themes. They are both global challenges calling for a global solution, which will require multilateral cooperation. Climate change, associated with the international externality of greenhouse gas (GHG) emissions, is the first case of a truly global environmental problem and therefore can be thought of as a prototype transborder global threat.

From the establishment of the GATT in 1947, global free trade has been promoted multilaterally through international trade negotiation rounds. The multilateral trading system was legally institutionalized in 1994 at the conclusion of the Uruguay round when the Marrakesh Agreement established the World Trade Organization (WTO), the new pillar of global governance in charge of pursuing global free trade.

Similarly, the first-best solution to global environmental issues such as climate change would be a multilateral environmental organization. However, as this is unlikely to become a reality in the near future we must accept multilateral environmental agreements (MEAs) as the best forum for addressing global environmental issues.

Although potential synergies exist between trade and the environment (Anderson and Blackhurst, 1992; Cosbey, 2004; Esty, 2001; Galeotti and Kemfert, 2004; Green, 2005; Panayotou, 2000), to date the WTO has not been very successful in dealing with trade–environment issues and, given the current slow progress towards a multilateral trading system, significant changes seem unlikely to emerge in the short run. At the same time, regional trade agreements have become a preferred forum in which to accelerate and deepen trade liberalization. As a consequence, this seems a good time to analyse how the trade–environment linkage is addressed within regional trade agreements.

In doing so, we will want to bear in mind the following background information. First, the EU was an early promoter of both regionalism and

region-to-region trade, but more recently the 'Lamy doctrine' has halted the instigation of any new regional trade negotiations while the Doha round of WTO negotiations is in progress. Meanwhile, the US has tended to accelerate its programme of regional trade agreement (RTA) negotiations, concluding a number of bilateral (for example EU–Jordan, EU–Saudi and recently EU–Morocco) and regional deals (for example CAFTA and potentially FTAA).[1]

Secondly, within its free trade agreement (FTA) negotiations the EU style has been much more likely to include elements of environmental and health protection via the *acquis*, most probably for the reason of commercial reciprocity (for example concerns to ensure developmental parity, equity, sustainability and so on).

So the question driving this chapter is how trade policy – that is, liberalization through preferential regional agreements – interacts with national and multilateral environmental regimes and therefore may promote the use or appreciation of environmental measures. In particular we have tried to shed some light on what, if any, are the channels by which trade regionalization can make the implementation of climate policies more attractive and therefore stimulate sub-global cooperation and, in a secondary effect, speed up progress in international negotiations. Important related questions are the following:

- Are RTA members more able to protect the environment locally rather than globally?
- Do regional trade agreements have a higher or a lower level of ambition for environmental issues compare to the WTO?
- In what different ways do RTAs deal with environment and climate protection?
- Is the emergence of regional environmental agreements more likely to 'lock in' a local regulatory-environmental process, or do regional blocs merely represent a 'stepping stone' towards a multilateral agreement?

4.1 TRADE REGIONALISM: WHAT'S NEW?

The 1990s witnessed the beginning of a new wave of regionalism. While the driving force of the old regionalism was an import substitution strategy, the new regionalism has tended to be more outward looking, and generally aimed at promoting further integration into the global economy.

However the issues are actually quite complex, for what we are discussing in practice is the extent to which a country's membership of international

agreements – of various kinds, be they trade related or otherwise – can shape its domestic behaviour in environmental and resource management.

Here a brief typology may be useful:

- First, there are primarily trade agreements, with possible environmental components.
- Second, there are primarily environmental agreements, which may have implications for trade concerns (but these are few and weak, for example CITES).
- Third, we have the possible behavioural consequences for environmental management and (our present concern) climate change.

Since the 1970s, more than 200 multilateral environmental agreements (MEAs) have been established. A few of these contain specific trade measures, whereas the majority do not (UNEP, 2000). However, serious problems can arise when the implementation of MEA obligations requires the use of measures with trade implications, as it is likely to be the case in the UN Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol.

Since 1958, several key trading blocs have consolidated their integration process. The EU became a full single market and North America established a free trade area (NAFTA); the ASEAN group launched the AFTA free trade area and is now contemplating extending this to a customs union (ASEAN economic community, AEC) by 2020. Alongside the institutional deepening within RTAs, a widening process in regional integration across different RTAs also began to take place. From the end of the Uruguay round in 1994 no significant regional blocs have emerged, but rather fully-fledged RTAs have started a process of 'bilateral regionalism' either with a country or with a region. Here we adopt a broader interpretation of the term 'bilateral regionalism' or 'bilateral agreement' so as to include not only country–country examples, but also region–region and region–country cases.[2]

So, defined as above, bilateral agreements now account for more than half of RTAs in force and free trade areas are the preferred configuration (see Box 4.1). The EU has played a leading role in this process as more than half of RTAs notified at the end of 2000 were concluded by the EU. The EU has been negotiating bilateral agreements with countries such as Mexico, Chile, Central and Eastern European countries (CEECs), Russia and Canada, and is involved in the first inter-regional agreement with Mercosur. The NAFTA parties are also engaging progressively in bilateral relations: Canada established a FTA with Chile, Costa Rica and the EU; the US also has an FTA with Chile and Jordan.

BOX 4.1 TYPE OF REGIONAL INTEGRATION

From the establishment of the first trade agreement, the General Agreement on Tariffs and Trade (GATT) in 1947, the multilateral trading system accepts preferential trade agreements that meet the criteria set out in GATT Art. XXIV and in General Agreement on Trade in Services (GATS) Art.V. RTAs can choose the following configuration:

- Free trade area: trade restrictions are removed within the group but each member retains its own tariff structure towards non-members.
- Customs union: a free trade area with a common external trade policy.
- Common market: a custom union which also allows for free movement of factors of production.
- Economic Union: a common market which also adopts common macroeconomic policies and harmonizes national policies of member states.

Source: Hoekman and Kosteki (2001), Urata (2002).

Table 4.1 Length of trade rounds

Name of the round	Trade agenda	Duration (years)
Geneva, Annecy, Torquay, Geneva, Dillon	Tariffs	1
Kennedy	Tariffs+non tariffs	4
Tokyo	Tariffs+non tariffs	6
Uruguay	Tariffs+non tariffs	8

The current wave of new regionalism appears to have coincided with a slowdown in multilateral trade negotiations. While international trade rounds were quite successful when dealing with the reduction of tariff and quantitative measures, as the trade agenda has widened to include more sensitive issues such as subsidies, antidumping, technical regulations and services, the length and complexity of trade rounds has increased (see Table 4.1).

Low tariffs have made the existence of different regulatory systems more visible and now the main trade concern is how to deal with domestic

policies and domestic regulatory measures (subsidies, technical regulations, product standards, services and intellectual property rights) that can impact upon trade and investment flows and reduce market access. The 'negative list' approach used so far in addressing tariff and quantitative measures is unlikely to suit these new issues, which require deeper integration and some degree of harmonization (Hoekman and Kosteki, 2001).[3] Deeper integration and regulatory harmonization are very hard to achieve multilaterally because in most cases they involve issues of a 'bottom-up' nature.

Against this background, RTAs are likely to be a more appropriate forum where non-tariff measures can be addressed. The restricted membership of an RTA presents the advantage of a smaller number of players with potentially a greater convergence of preferences. RTA negotiations can proceed faster than multilateral ones, especially on issues that have a strong regional dimension and are politically sensitive, which is the case for many environment-related questions. Successful agreements at the regional level may facilitate the establishment of and compliance with multilateral agreements. The lack of progress in the WTO on the regulation of 'new areas' could even represent an incentive for the creation of new RTAs (Urata, 2002). Going beyond the assessment of the immediate welfare effects of RTAs, recent studies therefore emphasize their specific contribution to the harmonization of rule making with respect to these 'new areas'.

In some areas many RTAs are not only 'WTO-compatible' but also 'WTO-plus'. What this means is that RTAs go beyond the WTO when dealing with services, investments, government procurement, intellectual property rights protection, trade facilitation, labour mobility and competition, contingency protection and environment (OECD, 2003; Sampson and Woolcock, 2003). So, essential questions are whether RTAs are rivals to multilateral progress, whether such agreements can complement multilateral trade liberalization and whether they are successful in promoting the implementation of global environmental agreements.

If RTAs prove to be a better forum in which to deal with non-tariff and domestic regulatory barriers to trade, when compared to the multilateral system, more progressive environmental trade-related measures could be a consequence.

In practice, however, a broad range of domestic polices aimed at protecting the environment may have an impact on trade. And for this reason such policies have provoked controversy at the multilateral level, for example eco-labelling and food safety regulations, environmental standards, and procurement measures (Green, 2005).

Hence, in the situation where an international agreement (be it trade or environment) would be desirable, but either is not feasible or is likely to be slow to achieve, could regulatory harmonization, which is on the agenda of many regional agreements, be a desirable alternative way forward? If so, we would need to examine the implications for the trade–environment debate of the process of regional harmonization.

4.2 GLOBAL ENVIRONMENTAL PROBLEMS: THE CASE OF CLIMATE CHANGE

Climate protection can be viewed as a global 'public good' which means that there are few incentives for unilateral mitigation, because these can be frustrated by the opportunistic behaviour of other actors who would benefit from having cleaner air at zero cost (free-riding). Hence, in order to be effective, climate change mitigation requires a global-cooperative solution. The foundations of an international approach to climate change were laid down by the UN Framework Convention on Climate Change in 1994.

Although the Kyoto Protocol has recently become operational (following Russian ratification in November 2004), it is still premature to talk about an international climate agreement. In fact, some big countries such as the US will probably resist international pressure to ratify the Kyoto Protocol while other major emitters from the developing world are yet to accept major quantitative reduction targets after 2012 when the Kyoto Protocol expires.

Any action which does not involve these key players can hardly be considered a global approach. Instead, different local climate approaches have been emerging. Whereas the EU will stick to its major role in promoting the Kyoto commitments, the US is looking for more long-term strategies. However, it can be argued that the aims of the UNFCCC and the Kyoto Protocol can be aligned with WTO commitments. In practice, the UNFCCC does not mandate specific policies and measures but sets targets that must be achieved via domestic policies. The important thing is that WTO trade rules – through disciplines on subsidies, border measures, technical requirements, government procurement and taxes – determine the options countries can use to achieve their domestic policy goals (Sell et al., 2005; ICTSD, 2005).

Since regionalism has proved to be more far-reaching than multilateral trade negotiations in its coverage of domestic measures and environmental regulations, it might represent a reasonable opportunity for strengthening the credibility of controversial climate-related measures. Indeed, as greenhouse gas (GHG) emissions relate to almost all human-economic

activities, climate measures are likely to have trade effects. Although the Kyoto Protocol does not contain specific trade obligations (STOs), some of the measures available to parties to implement the protocol may have trade effects: subsidies for renewable energy or research and development; carbon taxes; climate-friendly standards and labels for goods and services energy use; regulatory quotas on renewable energy use; government regulations that favour products and processes that are environmentally preferable.

Potential conflicts between regulatory measures of this kind and the WTO can arise from the sort of unilateral environmental measures mentioned above that are not explicitly aimed at trade goals, but which might have an actual or potential impact on trade (Green, 2005). For example, energy efficiency standards based on processes and methods of production and eco-labelling schemes may be questioned as disguised barriers to trade that discriminate against 'like products'. However, trade frictions can be reduced by establishing international common measures and methodologies. For example, cooperation within the Kyoto framework in defining measures of this kind could reduce the scope of conflict within the multilateral trading system. RTAs, by requiring regional harmonization for example in product standards and technical regulations, can represent a 'second-best' option to attain the same outcome.

For example, the European Union published a Green Paper on energy efficiency in June 2005. One of the issues raised in this document is the possibility of using tariff discrimination within the WTO for energy-efficient products and encouraging other members of the WTO to do the same.[4]

4.3 A SUB-GLOBAL APPROACH TO GLOBAL ISSUES: A PARADOX?

We have seen that trade liberalization and climate change share the common characteristic of being global issues: in both cases, the first-best solution would be a multilateral agreement. However both international trade and climate negotiations are progressing slowly. The increasing tensions within multilateralism have been illustrated by the breakdown of the WTO Ministerial Meeting in Seattle in 1999, by the failure in Cancun in 2003 and by the withdrawal of the US from the Kyoto Protocol. Despite the recent ratification of the Kyoto Protocol, some uncertainties still surround the debate over the post-Kyoto 2012 architecture.

Paradoxically, it might be more realistic to aim for worldwide cooperation in a sequential way rather than in one multilateral step. As regards trade

liberalization, it is broadly (although by no means universally) accepted that regionalism is complementary to multilateralism. Furthermore, it is now being suggested that the WTO can deal with controversial new issues such as investment, government procurement and regulatory measures.

Since regional negotiations are easier to agree and quicker to conclude, the cooperative attitude on trade might even spill over to the environmental domain. Moreover, now that trade talks are getting 'deeper', regional trade negotiations offer an opportunity to develop a more cooperative culture especially in the more sensitive issues, where countries have often been reluctant to make concessions due to fears of a reduced ability to protect their domestic preferences.

Cooperation on climate mitigation could also come about as a side-effect of regulatory harmonization. On the one hand, there is a risk of 'regulatory regionalism', that is, of having several RTAs with heterogeneous regulatory systems. Where environmental concerns are deeply shaped by domestic preferences, RTAs might be seen as a 'fortress' in which to protect local interests better. On the other hand, regulatory harmonization and convergence is occurring not only within RTAs themselves but also across different regional blocs. Increasingly, regulatory harmonization is an important chapter in many trade agreements, especially those involving the EU. Hence multiple RTAs are more likely to pave the way for broader regulatory cooperation rather than close regulatory regionalism. Such a result could even lower the frictions between trade and the environment, as there would be less criticism of commonly established climate measures.

In summary, there are RTAs which deal with the environment but as yet no RTAs that deal with climate change. However, in the medium term RTAs probably must grapple with climate change issues because of their technology components, since a key element for any long-term approach to climate change mitigation is the development and the diffusion of new technologies.

As most emissions in developed countries come from energy supply and use, along with the transport sector (Egenhofer and Van Schaik, 2005; Barbier et al., 2004; Baumert and Pershing, 2004; EEA, 2004), enhanced investment and R&D in these sectors is needed for the transition towards a cleaner energy mix and more sustainable transport systems. Since they can incorporate more detail in these areas, RTAs may be able to go further in incorporating deep technology solutions than can multilateral agreements.

To summarize the argument so far: by enhancing the opportunities for using environmental measures, regional trade agreements might be a more promising channel through which trade policies could have a positive impact on global concerns such as climate change. This possibility will be investigated in the next section.

4.4 RTAs AND THE ENVIRONMENT

To recap our core argument, the present state of 'world governance' is a complex and functionally unsatisfactory affair, depending as it does on nineteenth-century concepts of the nation state. In short, no world organ of governance presently exists, and we are left with the 'second-best' solution of multilateral treaties between sovereign states that serve – however imperfectly – to mimic the degree of global governance required to do justice to challenges to the 'global commons' such as transboundary pollution, or global warming and climate change.

As regional integration has become extremely topical since 1990, our focus here is on the extent to which increasing regional integration will amplify or undermine the multilateral agenda, such as that of the WTO, as regards environmental and climate provisions, in respect to, for example, technology transfer. In short, can regional agreements advance climate change objectives more than multilateral agreements?

One idea is that the more consolidated, cooperative attitudes characterizing RTAs might spread to other fields of integration. Trade liberalization has become more a matter of regulatory harmonization and thus there is more scope for convergence in climate measures such as standards, regulations and labeling schemes.

Most RTAs follow the language of WTO rules, recognizing the same broad principles and exemption clauses as the GATT.[5] Many contain language in their preambles recognizing the need for environmental protection and the achievement of sustainable development objectives. However, they differ significantly in the institutional structure through which these principles are administered. Whereas in the WTO provisions for environmental measures are integrated into the various agreements and addressed in committees, in a number of RTAs the environment is also the subject of separate agreements on environmental cooperation. In addition, several RTAs that did not initially contain specific provisions on the environment have since created separate protocols or instruments to deal with the environment in general, or with specific environmental problems.

For example ASEAN, which originated for trade purposes, in 1994 launched the Strategic Plan of Action on the Environment and in 2002 the ASEAN Cooperation Plan on Transboundary Pollution. Another example is Mercosur, born in 1991 and coupled with an environmental agreement only later in 2001 (see section 4.4.1).

The degree of harmonization arrived at varies, depending on the general motives underlying a given regional integration project, from trade facilitation to economic integration (Boas, 1999; OECD, 2003). RTAs can be broadly grouped into three 'ideal types' according to their

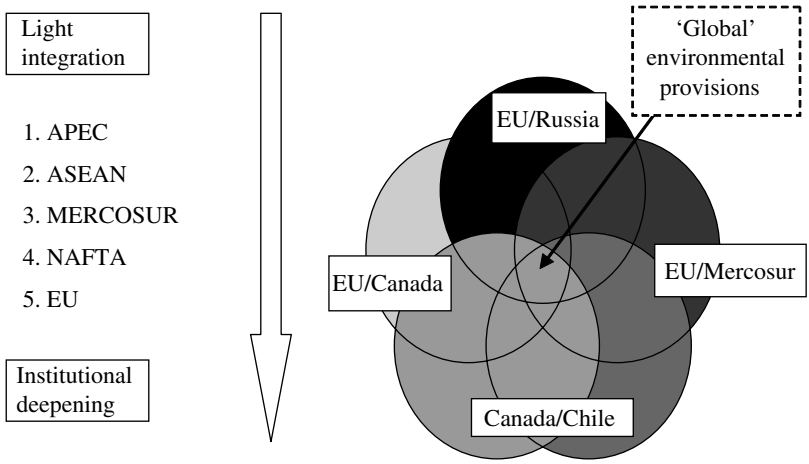


Figure 4.1 Institutional deepening versus widening in regional integration

scope and institutional characteristics along a continuum of vertical integration (see Figure 4.1) running from a pure trade motivation such as in APEC and ASEAN (light integration) to a full incorporation of trade with environmental standards such as in the EU (institutional deepening).

In addition to the process of vertical integration within regions, RTAs are increasingly widening in regional integration, bringing about a parallel process of horizontal interaction across regions (see Figure 4.1). As inter-bloc agreements are built on the previous integration experience of each RTA, they are likely to be wider in coverage and depth. Since they deal with new issues on which the WTO is lacking in experience, they can provide the multilateral regime with a blueprint of how to address non-tariff barriers to trade.

An OECD study on regionalism (2003) has identified three categories of provisions in which RTAs go beyond the WTO and that may encourage the implementation of climate-related policies.

1. Provisions aimed at preventing the relaxation of environmental standards for economic reasons. Faced with more competition in trade, an RTA could be induced to lower its standards and regulations so as to facilitate business both within the RTA itself and with external partners. However, the empirical evidence at the regional level along with the findings at the multilateral level do not support this hypothesis. Moreover, RTAs such as the EU and NAFTA contain articles explicitly aimed at avoiding this risk; these provisions are then recalled in

their bilateral agreements with third countries. This 'cascade effect' from major RTAs to smaller regional clusters might induce a 'bottom-up' approach towards the adaptation of a minimum level of common climate measures. Within an RTA, members tend to have stronger incentives to coordinate their environmental regulations so as to avoid competitiveness effects.

2. Provisions aimed at promoting technological cooperation on the environment. The benefits from the development of new technologies are higher if they are properly diffused (Galeotti and Carraro, 2003). A lot of technology transfer takes place through private companies and foreign direct investment (FDI). Technology cooperation in trade agreements can be an additional channel. The WTO does not contain specific provisions on technological cooperation whereas many RTAs do, especially the North–South type.[6] Technological cooperation aimed at enhancing the capacity building of developing countries, by increasing their ability to respond to climate change, may also propel their willingness to cooperate in a global agreement.

   On this issue, RTAs and the Kyoto Protocol seem to speak the same language. Article 4 of the UN Framework Convention on Climate and Change requires Annex I parties[7] to promote the application and the diffusion of technologies. Moreover, Annex I parties should take a leading role in advancing the capacity building of the developing countries: this means providing them with the financial and technical resources needed to mitigate vulnerability to the impacts of climate change and to response measures. The commitment to technological transfers and capacity building was reinforced later during the Seventh Session of the Conference of the Parties (COP 7) held in Marrakesh in 2001. There the parties agreed to a document aimed at developing concrete and effective measures to tackle capacity building and to enhance the implementation of the Articles of the Convention mentioned above.[8] One paragraph specifically deals with technology needs and technology transfer.[9]

3. Provisions aimed at exchanging information on the state of the environment on a regular basis. Enhancing information represents an important preliminary step towards environmental protection. The Convention openly states that parties should cooperate on research activities, education and training programmes in order to increase public awareness and support (UNFCCC, 2002). Information diffusion is particularly needed and strongly recommended in the case of climate change, where the scientific base is uncertain and the consequences are extremely difficult to perceive especially for those generations who bear the responsibility of solving the problem.

In conclusion it seems that, through these three channels, regional agreements provide a better chance than through multilateral trading systems of climate policy being successfully implemented, increasing at the same time the international credibility of climate change and thus the willingness to cooperate. Regional trade agreements not only represent an alternative route to global free trade, but they might be a more promising way for trade policies to promote a global approach to climate change.

To conclude, inter-bloc agreements – by linking different RTAs – have the potential to bring about a process of regulatory convergence across different blocs. By encouraging the adoption of common standards that in the long run may become international standards, bilateral agreements may eventually pave the way for a global consensus on regulatory measures. Since some regulatory polices can lower the burden on the climate system, such harmonization may make a positive contribution in terms of climate mitigation as it is often easier to accept a measure which responds to criteria agreed regionally, rather than a multilateral one that does not reflect specific national provisions.

In the next section we review vertical integration along three main types of RTAs (trade facilitation fora, free trade areas and customs unions, and economic union, see also Table 4.1) and the process of horizontal interaction, giving some examples.

4.4.1 Trading Blocs: the Continuum from APEC to the EU

Trade facilitation fora (for example ASEAN, APEC)

Trade-facilitating RTAs such as APEC[10] and ASEAN[11] started as trade initiatives aimed at enhancing regional political stability and economic prosperity of their members. APEC cannot be strictly considered a trading bloc and its integration process is based on the concept of open regionalism. Although environmental protection was not a priority when APEC was originally established, sustainable growth has become a goal, at least in principle, and to some degree APEC has shown an interest in promoting the compatibility between trade and environmental policies (Yonghai et al., 2000).

Being particularly concerned with economic growth, ASEAN founded its policies on the principle of 'grow now, clean up later' (Boas, 1999). Concerns for the environment emerged gradually and in 1994 ASEAN launched the Strategic Plan of Action on the Environment. In 2002 this was followed by the ASEAN Cooperation Plan on Transboundary Pollution. Although not explicitly targeted at responding to climate change, it can be expected to have positive implications in terms of GHGs reduction.[12]

Compliance monitoring does not rely on binding rules and environmental cooperation is coordinated by three working groups on the environment. Yet, one of the first goals of the plan is to enhance its institutional capacity in order to strengthen the environmental enforcement mechanism. ASEAN seems to be more EU-minded rather than NAFTA-minded since it has aspirations to harmonize different environmental policies and standards and it is in favour of undertaking joint actions. The ASEAN plan seems to have overcome the original reluctance towards trade–environment links expressing at least the intention of coordinating trade and environmental policies: for example, recognizing the value of studying the environmental implications of AFTA.[13]

Free-trade areas and customs unions with separate agreements on environmental cooperation (for example NAFTA and Mercosur)

The North American Free Trade Agreement (NAFTA) between the US, Canada and Mexico entered into force in 1994, just when the Uruguay round was being completed. Therefore NAFTA contains provisions similar to the GATT/WTO, although it is more far-reaching when dealing for example with services, investment and environmental rules. A first commitment to promoting sustainable development is included in the Preamble of NAFTA: to this end the need for strengthening the development and the enforcement of environmental laws and regulations is explicitly recognized. The monitoring and implementation of environmental regulations has been delegated to a specific side-protocol, the North American Agreement on Environmental Cooperation (NAAEC).

NAFTA members have agreed on a sophisticated institutional set-up to ensure their environment-related obligations are respected. NAAEC has created the Commission for Environmental Cooperation (CEC) which, besides promoting environmental cooperation between the three countries, is in charge of investigating cases of lax or non-compliance that may ultimately be enforced through the use of trade sanctions. The CEC should also evaluate and monitor the environmental effect of NAFTA and of the bilateral agreements of its members.

Although the NAAEC provides a unique institutional basis for effective, yet flexible compliance control, it is not openly aimed at developing common regional environmental regulations. Whereas the EU, Mercosur (see below), and even ASEAN have required their parties to coordinate environmental measures, the NAAEC does not: the CEC has to ensure their enforcement, but each country remains free to choose the level of protection that best suits its domestic preferences. This is particularly true in the case of climate change, where each member has adopted different strategies. Whereas Canada and Mexico committed themselves to the

Kyoto Protocol, the US went for a long-term approach based on investment in cleaner technologies.

NAAEC institutions and approaches are then replicated in the bilateral agreements of NAFTA members, for example the bilateral Canada–Chile agreement and the bilateral Canada–Costa Rica agreement.

Mercosur, the customs union between Argentina, Brazil, Paraguay and Uruguay, was established in 1991 by the Tratado de Asuncion[14] (Onestini, 1999) with the ultimate goal of accelerating the social and economic development of its members and increasing their participation in the world economy. This is to be achieved through deep integration along European Union lines rather than the NAFTA model.

Despite the stated ambition of pursuing economic growth in a sustainable way,[15] a separate environmental agreement, the Acuerdo Marco sobre Medio Ambiente del Mercosur, was reached only later in 2001.[16] Contrary to the sophisticated environmental structure of NAFTA, Mercosur does not have rigorous environmental institutions: environmental actions are managed and coordinated by the Environmental Working Group of the Common Market (SGT6) and by the Reunion de Ministros de Medio Ambiente, established in 2003. Controversies that arise between Mercosur parties as to the implementation and interpretation of environmental provisions have to be resolved within the Mercosur system of resolution as outlined in the Protocol de Brasilia para la Solución de Controversias, 1991.

The reciprocity and the complexity between the trade and environmental policies are openly acknowledged by the environmental agreement of Mercosur. The Preamble recognizes that trade and environmental policies must be complementary and not substitutes because trade liberalization, if wisely managed, can be good for the environment. Moreover, environmental policies have to be neither restrictive nor distorting for trade in goods and services.

In Mercosur, climate policy is still a national issue. Nevertheless, Mercosur's members have been implementing climate-related policies. The protection of the atmosphere and of the air's quality is among the priorities listed in the Annex of the agreement, along with other climate-related areas.[17] Members are aware of the role of information exchange and research and development (R&D) for the development of cleaner technologies and, to this end, they propose incentives to R&D. The Acuerdo Marco explicitly recognizes the importance of harmonizing and coordinating different national initiatives and explicitly foresees the possibility of establishing further agreements on specific issues, if necessary to comply with the international agreements ratified by its member states such as the Kyoto Protocol.[18]

Economic unions with integrated environmental dimension (that is, the European Union)

In the context of a more politically integrated entity, the EU offers the most comprehensive coverage of the trade–environment linkage. In 1985, the Single European Act (SEA) integrated Community environment policy into the treaties (Art. 175 TEC). Since then, protection of the environment has become one of the Union's central policy objectives. It is included in the Community's principles and tasks (Art. 2, 3 TEC) and must be taken into account in all Community policies including trade (Art. 6 TEC). In contrast to the WTO framework, environment no longer has the status of an exception which must be positively argued for within strict constraints, but is 'a competing or co-equal policy in its own right' (De Burca and Scott, 2000; McCormick, 2001; Jordan, 2002; Connolly and Smith, 2003).

In contrast to other Community policies such as trade, the EU competence in environment is based on shared responsibility among the member states. The EU has set up a system of common standards and binding norms that can be enforced by the European Court of Justice. Directives are the major legislative instrument used to translate European environmental objectives into concrete national policies and measures. In fact, EU environmental legislation is very broad and covers more than 300 items, dealing with every aspect of environmental policy (UNEP, 2000; Van Schaik and Egenhofer).

EU sustainable trade is an emblematic example of trade–environment integration. The trade–environment link is addressed not only within environment policy, but all Community policies should be integrated with the environmental dimension.

To conclude, can RTAs be said to contain environmental provisions that are more far-reaching than those defined multilaterally by the WTO? As summarized in Table 4.2, not only have RTAs broadly covered the topic, but they have also raised the status of environmental protection from a mere exception, as is the case in the WTO, to a goal *per se* that deserves a specific agreement or a protocol. All RTAs here analysed have institutionalized concerns for the environment only as a secondary consideration: therefore it can be inferred that the cooperative attitude on trade has also enhanced the willingness to cooperate on other items such as environmental protection.

4.4.2 Inter-Bloc Agreements: Enhancing Environmental Provisions?

So far we have seen how individual trading blocs have dealt with the environment in specific and separate agreements. However, the number of region–region bilateral agreements has been increasing markedly. This type of bilateral regionalism has shown a preference for multidimensional

Table 4.2 Environmental provisions in trading blocs

Description	ASEAN	Mercosur	NAFTA	EU
Date of establishment	1967	1991	1994	1958
Members	Indonesia, Malaysia, the Philippines, Singapore, Thailand, Brunei, Vietnam, Laos, Myanmar, Cambodia	Argentina, Brazil, Paraguay, Uruguay	United States, Canada, Mexico	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, Sweden, United Kingdom + 10 new member states
Environmental provisions	ASEAN Strategic Plan of Action on the Environment, 1994–1998	Acuerdo Marco sobre Medio Ambiente, 2001	NAAEC North American Agreement on Environmental Cooperation, 1994	Art. 175 TEC, 1985
Institutions for the environment	Three Working Groups, one on MEAs	Environmental Working Group of the Common Market Group (SGT 6)	Commission for Environmental Cooperation–Council, Secretariat, Joint Public Advisory Committee	The Council of Ministers, the European Parliament, the European Commission, the European Court of Justice
Climate change policy	ASEAN Strategic Plan of Action on Transboundary Pollution 2002	National measures	National programmes	The common and coordinated climate change polices + national policies
UNFCCC membership	Indonesia, the Philippines, Singapore, Myanmar, Cambodia, Malaysia, Thailand, Vietnam, Laos	√	√	√
Kyoto membership	Malaysia, Thailand, Vietnam, Laos, Cambodia	√	Mexico, Canada	√

agreements to address different items simultaneously, such as trade liberalization and environmental protection. One explanation could be the greater complexity of the new trade issues. While tariffs and quantitative measures could easily be brought down by the 'negative list' approach, in order to address non-tariff measures harmonization and deeper integration are required (Hoekman and Kostecki, 2001). A second reason is that most inter-bloc agreements involve countries that have already had a regional integration experience at home.

Bilateral agreements established by the EU tend to share similar structures, irrespective of whether the trading partner is a candidate country or an overseas partner. Indeed, the same pattern has been observed in different types of agreements (see Table 4.3).

Besides trade liberalization that in most cases covers services, investment, government procurement and intellectual property rights, other areas of cooperation such as financial, institutional, cultural, scientific and economic cooperation are also envisaged.

Environmental cooperation usually falls within the chapters dealing with economic cooperation, but the degree of detail varies from case to case. While the EU–Mercosur relationship does not address specific environmental problems, the Europe Agreements[19] and the Partnership Cooperation Agreement with Russia (PCA) are more comprehensive and do make specific commitments. The Europe Agreements asked former candidate countries[20] to strengthen their cooperation in combating urgent environmental problems such as climate change.

The EU–Russia trade negotiations have explicitly called for harmonizing environmental standards and regulations; among the main problems to be confronted is global climate change. The PCA recommends the sustainable and efficient production and use of energy.[21] The bilateral market access negotiations for the accession of the Russian Federation to the WTO signed on 21 May 2004 lists as key elements an explicit commitment to environmental and energy services. In particular, Russia will be increasing domestic energy prices so as to encourage more efficient use of energy resources.[22] The Russian commitment to climate mitigation became 'public' after its ratification of the Kyoto Protocol on 18 November 2004.

In EU–Canada relations the first commitment to environmental protection was made in the Framework Agreement for Commercial and Economic Cooperation in 1976, in the chapter on economic cooperation. The EU–Canada Partnership Agenda and the Trade and Investment Enhancement Agreement (TIEA) in 2004[23] has enhanced and strengthened the original agreement by adding more specific provisions on environmental cooperation. The Partnership Agenda has a specific section addressing 'Cooperation on Global and Regional Challenges'. Within this context, the

Table 4.3 Environmental provisions in the inter-bloc agreements

	EU–CANADA	EU–CEECs (Europe Agreements)	EU–Mercosur	EU–RUSSIA	CANADA–CHILE
Start of negotiations	1976	From 1990s	1995	1997	1997
Notification to the WTO	NO	OK	NO	NO	OK
Type of agreement	Framework Agreement for Commercial and Economic Cooperation, 1976 Partnership Agenda and Trade And Investments Enhancement Agreement (TIEA), 2004	FTA or services agreement	Interregional Framework Cooperation Agreement	PAC (Partnership and Cooperation Agreement)	FTA
Environmental provisions	Economic Cooperation, 1976 TIEA, sustainable development; Partnership Agenda, Cooperating on Global and Regional Challenges, 2004	Economic cooperation, 1990s	Economic cooperation, 1995	Economic cooperation, 1997	CCAEC, side agreement, 1997
Regulatory cooperation	OK	OK	OK	OK	NO

importance of environmental cooperation is acknowledged and the EU and Canada have committed themselves to work together in order to bring the Kyoto Protocol into force. The EU–Canada trade initiative (TIEA) also addresses sustainable development and it requires cooperation on environmental regulations. In the yearly summit on 19 June 2005 both sides have reaffirmed their commitment to the Kyoto Protocol and to intensify discussion on the post-2012 international framework for combating climate change.[24]

The Chile–Canada relationship has a completely different structure, which however reflects the NAFTA approach. As NAFTA has a side environmental agreement (NAAEC), symmetrically CAFTA came along with the Canada–Chile Agreement on Environmental Cooperation (CCAEC). It must be said that the environmental institutions of the CCAEC are advanced when compared to the EU bilateral agreements with non-candidate countries[25] which do not tend to set up specific environmental bodies. CCAEC relies on activities of the Commission for Environmental Cooperation and the enforcement mechanism, different from NAAEC, based more on cooperative solutions rather than trade sanctions.

A common characteristic of most RTAs is the recognition of the value of information exchange, technical assistance, capacity building, training and education as fundamental practices aimed at increasing the perception of environmental challenges and thus at creating a more favourable context for environmental cooperation.

Against this background, can inter-bloc agreements be said to be capable of enhancing environmental provisions?

What is significant is the approach by which bilateral trade liberalization has addressed environmental protection. Whereas individual RTAs have originally limited regional cooperation to trade and extended it to the environment only later, inter-bloc agreements have simultaneously addressed heterogeneous items using the same cooperative approach. Moreover, inter-bloc agreements did lay the ground for a gradual process of regulatory convergence across different blocs. In the EU bilateral agreements, regulatory cooperation or legislative approximation is often an outspoken goal (Table 4.2). NAFTA in principle rules out the harmonization of environmental standards and regulations; however an internal *de facto* convergence towards the US levels is taking place (Sampson and Woolcock, 2003).

4.5 CONCLUSIONS

A motivation for this study has been to assess the implications of any shift away from multilateral to regional trade agreements for the trade–

environment interface. The WTO failure at Cancun in 2003 raised fears that 'competitive liberalization' might undermine progress at the multilateral level. Some would argue that the world trade system can be thought of as a four-wheeled vehicle, in which the multilateral route represents one wheel, the regional and sub-regional route represents another, while the unilateral and bilateral routes represent the other two. Essentially, in this vision the vehicle performs best when all four wheels are driving forward together, while progress can probably still be made when one wheel is out of action. This will be particularly true if the trade agenda is 'deepened' so as to include domestic regulatory measures on which the WTO has a limited experience and on which global cooperation will be more difficult to secure than for simple tariff reduction.

Given these multilateral complexities, RTAs may offer a 'better' forum in which to address such measures, enhancing the chances for more progressive environmental trade-related measures. The regional trade experiences reported here tend towards a conclusion that RTAs are offering the potential to amplify the multilateral environmental agenda. Moreover, RTA members seem to be more able to include environmental protection in trade agreements when compared to the WTO.

In particular RTAs do seem to include more climate-friendly provisions in three important areas. First, RTAs have gone beyond the multilateral trading system in the sense of including provisions preventing the relaxation of domestic environmental laws and the enforcement of those laws. Second, they appear to have promoted technological cooperation on the environment; and third, they have far exceeded present levels of multilateral ambition in requiring each party to prepare periodically, and make publicly available, a report on the state of its environment.

In particular, RTAs have gone beyond the WTO in incorporating many of the 'new issues' that have been so controversial at the WTO such as regulating government procurement, investment, intellectual property rights, competition and services – as well as the environment. Looking forward, these are all elements that, if properly managed, can provide stronger incentives to R&D and investment in climate-friendly technologies.

As regards individual differences among RTAs in the manner of addressing environmental protection, individual trading blocs such as ASEAN, Mercosur and the EU have all gradually extended regional cooperation from trade outwards to the environment. They have done this by adding in side-protocols or agreements dealing specifically with environmental protection and climate change mitigation. Contrastingly, most inter-bloc agreements have encompassed trade liberalization and issues related to climate protection simultaneously, in the same agreement. Only the Canada–Chile free trade area relies on a side-agreement which was however

established along with the trade agreement, exactly following the NAFTA approach.

Finally, our conclusion is that the fear of 'regulatory regionalism' does not seem to be well founded and RTAs can reasonably be expected to represent a stepping stone towards multilateral agreements rather than a serious impediment. Moreover, regulatory cooperation is not only of increasing interest within individual RTAs, but the process of vertical integration is prompting a widening in regional integration across regions, which in the long run might even lead to a convergence between different regulatory systems (see Pelkmans et al., 2000).

Since significant environmental policies that promote the reduction of GHG emissions are regulatory measures (for example energy efficiency standards, energy labelling schemes, green procurement) harmonization can contribute to a global response to climate change by encouraging, in a 'bottom-up' fashion, the adoption of common standards that in the long run may yet become international standards.

In this process of promoting regulatory cooperation, we argue that the EU has played a leading role. How far the political stance of the EU in promoting sustainable trade and regulatory harmonization will go in this direction in the future is a real issue. European member states (both old and new) have discovered that operating with a unified position can strengthen their bargaining power. What may be of future interest is whether the deepening of regional integration which is occurring in other regions, such as ASEAN and Mercosur, might have the same external effect that it had in the EU case. For the time being, these regions do seem to look to the EU as an example to be emulated.

If the EU model of pooling national strengths can be 'exported', multilateral regimes could yet find it easier to make further progress across the range of complex non-trade areas discussed. Certainly as concerns both environmental and trade issues, and their possible impact on the political economy of climate change, this would happen simply because it is easier to negotiate such complex matters with fewer actors on the negotiating stage.

NOTES

1. Respectively, the Central American Free Trade Agreement and the Free Trade Area of the Americas, an attempt to expand the North American Free Trade Agreement (NAFTA).
2. For a recent survey on regional trade agreements see Crawford and Firoentino (2005).
3. A positive list approach to intra-regional trade liberalization proceeds on a product-by-product basis and involves a bilateral pair of countries requesting concessions on a list of products and partner countries offering concessions on the basis of their acceptance, or otherwise, of the same. In a negative list approach participating states agree to liberalize

all products, barring a negative list of product lines they do not wish to open up at present for various reasons. The negative list approach to trade liberalization has certain advantages over the positive list (product-by-product) approach, as once the negative (exclusion) list has been drawn up by each participating state, negotiating time can be saved as there will be no need to undertake several, often protracted, rounds of negotiations on a product-by product basis. This is particularly true of countries with a diversified trade structure.

4. See in particular section 6 of the 'Green Paper on Energy Efficiency or Doing More with Less' (EU Commission, 2005).
5. Either in their own wording (EFTA) or with direct reference to GATT Art. XX b, g (in bilateral US and Canadian agreements).
6. It must be said that the WTO has made some progresses in this direction: the Doha Development Agenda recognized the importance of technical assistance and capacity building (OECD, 2003).
7. Annex I Convention parties are OECD countries and countries with economies in transition. Non-Annex I parties are basically developing countries. Annex II parties are only the OECD countries.
8. Decision 2/CP.7: Capacity-building for developing countries (non-Annex I Parties), http://unfcc.org.
9. See Articles 3.4, 3.5, 4.1, 4.3, 4.4, 4.5 of the Convention (UNFCCC, 1992) and the Framework for capacity-building in developing countries of the Marrakesh Accord (UNFCCC, 2001).
10. The forum for Asian-Pacific Economic Cooperation. Established in 1989 it brings together Australia; Brunei Darussalam; Canada; Chile; People's Republic of China; Hong Kong, China; Indonesia; Japan; Republic of Korea; Malaysia; Mexico; New Zealand; Papua New Guinea; Peru; The Republic of the Philippines; The Russian Federation; Singapore; Chinese Taipei; United States of America; Vietnam.
11. Association of Southeast Asian Nations. Established in 1967, it comprises Brunei, Indonesia, Malaysia, the Philippines, Singapore, Thailand, Vietnam, Laos, Myanmar and Cambodia.
12. The plan primarily addresses air pollution related to agricultural bad practices and forest management. For more information about the ASEAN Cooperation Plan On Transboundary Pollution visit http://www.aseansec.org/8938.htm.
13. Strategic Plan of Action on the Environment 1994–1998, http://www.aseansec.org/8950.htm.
14. Its institutional structure was defined later in 1994 by the Protocolo de Ouro Preto. The decision-making body consists of the Southern Market Council (CMC), the Commerce Commission (CCM) and the Common Market Group (GMC). The latter is the executive body and it was originally made up of ten Working Groups (Subgrupos de trabajo – SGT).
15. The Preamble of the Tratado de Asuncion establishing the Southern Common Market recognizes that the objective of accelerating the social and economic development of its members 'must be achieved by making optimum use of available resources, preserving the environment, improving physical links'.
16. The Decision n.2/2001 of the Council of Common Market (CMC) established the Acuerdo Marco sobre Medio Ambiente del Mercosur.
17. Transport regulation, management of land use, renewable and alternative forms of energy, education and environmental communication, environmental technologies and forest management.
18. Acuerdo Marco sobre Medio Ambiente del Mercosur, Articles 5 and 6.
19. Europe Agreements were signed with Bulgaria, the Czech and Slovak Republics, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovenia. For more information see the European Commission website: http://europa.eu.int/comm/trade/issues/bilateral/regions/candidates/index_en.htm.
20. At the moment the remaining candidates that have a Europe Agreement with the EU are Romania and Bulgaria.

21. PCA, Art. 69.
22. http://europa.eu.int/comm/trade/issues/bilateral/countries/russia/pr 210504_en.htm.
23. The EU–Canada Partnership Agenda of 2004 is based on the former agreements and it was launched alongside the framework for the Trade and Investment Enhancement Agreement (TIEA), which deals more specifically with trade liberalization.
24. http://europa.eu.int/comm/trade/issues/bilateral/countries/canada/pr170605_en.htm.
25. Candidate countries having bilateral agreements with the EU, except Bulgaria and Romania, are now new member states and therefore share the complex system of European environmental regulations and institutions.

REFERENCES

Anderson, K. and R. Blackhurst (1992), *The Greening of World Trade Issues*, New York and London: Harvester Wheatsheaf.

Barbier, C., R. Baron, M. Colombier and C. Boemare (2004), 'Climate change policies: analysis of sectoral changes in Europe', Institut du développement durable et des relationes internationals (IDDRI), Paris.

Baumert, K. and J. Pershing (2004), 'Climate data: insights and observations', Pew Center on Global Climate Change, Arlington, VA.

Boas, Morten (1999), 'The trade–environment nexus and the potential of regional trade institutions', paper prepared for the CSGR 3rd Annual Conference, After the Global Crises: What Next for Regionalism?, University of Warwick, 16–18 September.

Connolly, J. and G. Smith (2003), *Politics and the Environment: From Theory to Practice*, London: Routledge.

Cosbey, A. (2004), *Lessons Learned on Trade and Sustainable Development*, Winnipeg: International Institute for Sustainable Development (IISD).

Crawford, Jo-Ann and R. Fiorentino (2005), 'The changing landscape of regional trade agreements', Discussion Paper no. 8, WTO, Geneva.

De Burca, Gráinne and Joanne Scott (2000), 'The impact of the WTO on EU decision-making', Harvard Jean Monnet Working Paper 06/00.

EEA (2004), 'Analysis of greenhouse gas emission trends and projections in Europe', European Environment Agency, Copenhagen, http://reports.eea.eu.int/technical_report_2004_7/en/tab_content_RLR.

Egenhofer C. and Louise Van Schaik (2005), 'Towards a global climate regime: priority areas for coherent EU strategy', CEPS Task Force Report no. 55, May.

Esty, D. (2001), 'Bridging the trade–environment divide', *Journal of Economic Perspectives*, **15**, 113–30.

EU Commission (2005), 'Green Paper on Energy Efficiency or Doing More With Less', 22.06.2005, COM (2005) 265 http://europa.eu.int/comm/energy/efficiency/doc/2005_06_green_paper_text_en.pdf.

Galeotti, M. and C. Carraro (2003), 'Traditional environmental instruments, Kyoto mechanisms and the role of technical change', in *Firms, Governments and Climate Policy. Incentive-Based Policies for Long-Term Climate Change*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.

Galeotti, M. and C. Kemfert (2004), 'Interactions between climate and trade policies: a survey', *Journal of World Trade* **38**, 701–24.

Green, A. (2005), 'Climate change, regulatory policy and the WTO: how constraining are trade rules?' *Journal of International Economic Law*, **8** (1), 143–89.

Hoekman, M.B. and Michel M. Kostecki (2001), *The Political Economy of the World Trading System*, 2nd edn, Oxford: Oxford University Press.
ICTSD (2005), 'Eco-Labeling Standards, Green Procurement And The WTO: Significance for World Bank Borrowers', prepared by the Center for International Environmental Law, Washington, DC and Geneva, Switzerland, March.
Jordan, A. (ed.) (2002), *Environmental Policy in the European Union*, London: Earthscan.
McCormick, J. (2001), *Environmental Policy in the European Union*, Basingstoke: Palgrave.
OECD (2003), *Regionalism and the Multilateral Trading System*, Paris: OECD Books.
Onestini, M. (1999), 'The Latin America Southern Common Market (MERCOSUR): environment and regionalisation', prepared for the CSGR 3rd Annual Conference, After the Global Crises: What Next for Regionalism? University of Warwick, 16–18 September.
Panayotou, T. (2000), 'Globalization and environment', CID Working Paper No. 53, *Environmental and Development Paper No. 1*.
Pelkmans, J., Sandrine Labory and Giandomenico Majone (2000), 'Better EU regulatory quality: assessing current initiatives and new proposals', in G. Galli and J. Pelkmans, *Regulatory Reform and Competitiveness in Europe*, Vol. 1, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.
Sampson, G. and S. Woolcock (2003), *Regionalism, Multilateralism, and Economic Integration. The Recent Experience*, Tokyo: United Nations University Press.
Sell M., B. Lee and M. Walls (2005), 'Emerging issues in the interface between trade, climate change and sustainable energy', ICTSD Discussion Paper, Geneva.
UNEP (2000), *Environment and Trade: a Handbook*, Geneva: UNEP.
UNFCCC (1992), 'United Nations Framework Convention On Climate Change', http://unfccc.int/resource/docs/convkp/conveng.pdf.
UNFCCC (2001), 'The Marrakesh Accords and the Marrakesh Declaration', http://unfccc.int/cop 7/accords_draft.pdf.
UNFCCC (2002), 'A Guide to the Climate Change Convention and its Kyoto Protocol', Climate Change Secretariat, Bonn.
Urata, Shujiro (2002), 'Globalization and the growth in free trade agreements', in *Asia-Pacific Review*, **9** (1), 20–32.
Van Schaik, L. and Christian Egenhofer (2005), 'Improving the climate: will the new Constitution strengthen EU performance in international climate negotiations?' CEPS Policy Briefs No. 63, February.
Yonghai, Shi, Yang Jijian, Li Yongjiang and Zhang Xiaoyu (2000), 'APEC trade liberalization and China: coordination of environmental and trade polices', Chinese Academy of International Trade and Economic Cooperation.

5. Participation incentives and technological change: from top-down to bottom-up climate agreements[1]

Barbara Buchner and Carlo Carraro

Since the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, climate change has become a key issue in international environmental negotiations. General consensus has emerged that drastic reductions in greenhouse gas (GHG) emissions are necessary to stop the progress of global climate change. In order to achieve these large-scale reductions, innovative strategies will be required to improve the effectiveness of international climate policy. In this context, the development and adoption of new technologies play a key role.

Several recent publications have stressed the importance of technological change and research and development (R&D) in halting the threat of climate change, providing indications that an effective climate policy requires large technical changes and technological breakthroughs. There is ample empirical evidence to support the idea that stimuli to technological change play a crucial role in the reduction of emissions. Pacala and Socolow (2004) demonstrate that fundamental research is vital in helping to develop the revolutionary mitigation strategies needed in the second half of the 21st century and beyond. Such research is putting forward the proposition that currently available energy technologies would already be sufficient to meet the world's energy needs for the next half-century by keeping carbon emissions at current levels instead of doubling them as current emission trajectories would suggest. However, the current technological portfolio is unlikely to bring about the stabilization of GHG emissions in the atmosphere, unless the willingness to pay for emissions abatement is extremely high. To achieve low emissions concentration levels it would therefore be important to accelerate the diffusion of existing low-emitting technologies and to change consumers' behaviour (see Philibert, 2005a, 2005b). At the same time, the energy system will have to undergo profound changes in order to achieve the stabilization of GHG concentrations, because the

existing set of low-emitting technologies may not be sufficient to achieve this target. A stringent climate policy may be able to induce a sufficient amount of climate-related technological change, particularly in the form of the innovation and diffusion of environment-friendly technologies, which in turn lower emissions (see Sijm, 2004).

A decade ago, Ausubel (1995) made a quantitative study of cases of long-run technical change in which he demonstrated the significant contribution of technology towards decarbonization over the past 100 years. The history of technology, particularly related to the decrease of the carbon intensity of primary energy, has shown how the cost structure of mitigation and adaptation policies has changed over time by making climate change control cheaper than ever before. This insight is also confirmed by recent research results that indicate a significant reduction in carbon mitigation costs through the research, development and demonstration (RD&D) support of new low-carbon technologies (Kypreos, 2005). Given the currently expensive backstop systems in the energy markets, RD&D policies act as a prerequisite to establishing this technological development at the required level. As a consequence, the support of climate-friendly technologies is likely to play a major role, also because the accumulation of experience leads to a further lowering of costs.

Given the importance of technological change, innovation and R&D are often directly or indirectly part of climate policy proposals. When such proposals refer directly to technical change, they advocate the establishment of funds for environment-friendly technologies or green investment schemes, whereas policy proposals that call for investments in R&D tend to refer to technical change indirectly. An international strategy for the development and diffusion of technologies designed to reduce GHG emissions has indeed often been proposed as a possible approach – either as a complement to or a substitute for the present climate regime – that countries may decide to adopt in order to combat climate change (see Barrett, 2001, 2002; Benedick, 2001; Buchner et al., 2005; Edmonds and Wise, 1998; Edmonds et al., 2000; Edmonds, 1999, 2002; Flannery, 2001; Jacoby, 1998). An overview on these proposals will be provided in section 5.1.

A further aspect of technological change is that by lowering mitigation costs it provides greater participation incentives for countries to sign environmental agreements. This is even more true if emissions trading is allowed, because technical change can then be used to increase revenues from the selling of permits. In addition, incentives to free-ride are much smaller where there is effective international cooperation on environmental technological innovation and diffusion than they are in the case of cooperation on emissions control. This point is supported both by theoretical arguments and empirical facts. First, theory suggests that incentives to free-ride

are much smaller in the case of technological cooperation than in the case of cooperation on emission control (see Carraro and Siniscalco, 1995, 1997; Yi, 1997). Second, in recent years countries have begun to adopt domestic policy measures and to sign bilateral and multilateral deals to enhance investments in R&D and the diffusion of climate-related technologies (see Buchner and Carraro, 2005a).

As far as we know, the link between technological change and participation incentives has always been analysed in the context of a single global climate agreement (the main results will be summarized in section 5.2). However, recent negotiations suggest that it might be difficult to achieve a single global agreement. Instead, regional or sub-global climate agreements may emerge as a first step to coping with climate change (see Buchner and Carraro, 2007; Egenhofer and Fujiwara, Chapter 3, this volume). This phenomenon has also been observed in the context of trade negotiations. The main objective of this chapter is to look at what role R&D and innovation play in the context of various bottom-up regional agreements. Section 5.3 will tackle this issue, and highlight its implications in terms of the strategic behaviour of players. The analysis will be based on the FEEM-RICE model, which is briefly explained in section 5.3. Finally, section 5.4 draws conclusions on how R&D might foster the emergence of regional or sub-global climate coalitions, and outlines future research directions.

5.1 AN OVERVIEW OF CLIMATE POLICY PROPOSALS BASED ON TECHNICAL CHANGE

The Kyoto Protocol came into force on 16 February 2005, and has been welcomed as an important political step in coping with climate change. Nonetheless, there is general consensus that this treaty can be considered only as a first step towards the stabilization of GHG emissions, given its low environmental effectiveness. In particular the lack of several key players, most importantly the US, Australia and the larger developing countries, highlights the weaknesses of the current approach to climate change. As a consequence, the need to enhance climate cooperation is reiterated both by politicians and in all the recent literature on climate negotiations.

Given the prominent role played by technical change, climate-friendly technologies and R&D in general have been identified as central elements of policy strategies that can induce more countries to participate in international efforts towards climate control. A recent strand of literature has therefore focused on economic mechanisms based on technological change that are expected to promote cooperation, both directly and indirectly.[2] Let us briefly analyse these policy proposals.

Pointing out the fact that efficient policy instruments, such as taxes or tradable permits, often fail to be implemented, Edmonds and Wise (1998) propose a so-called 'Technology Backstop Protocol', which is expected to serve as a 'backstop' in cases where the first-best policy option fails. This standards-based approach was again promoted by Edmonds in later works (1999, 2002). In particular, any new fossil fuel electric power plant and any new synthetic fuels plant installed in industrialized countries after 2020 would be required to capture and dispose of any carbon dioxide from its exhaust stream or conversion processes. If the per capita income of developing countries equals the average for industrialized countries in 2020 in purchasing power parity terms, then they would also be required to undertake the same obligations.

The idea that technological cooperation is the most appropriate tool for dealing with the problem of global warming has been put forward by other authors as well. For example, Barrett (2001, 2002) and Benedick (2001) argue that an international protocol for the development and diffusion of technologies designed to reduce GHG emissions could be a possible strategy that countries will decide to adopt to combat climate change.

In particular, Barrett (2001) argues that the Kyoto Protocol provides poor incentives for participation and compliance and tries to solve this problem by suggesting an alternative climate regime based on common incentives for the development and adoption of climate-friendly technologies. The main elements of this proposal include the cooperative funding of basic R&D into energy-saving, climate-friendly technologies on the one hand, and the implementation of various standards directed towards the worldwide adoption and diffusion of new technologies on the other. Common standards for technologies are identified through collaborative research efforts, which are financed through the global R&D fund. Every country should be given the option to sign both the standards protocol and the cooperative R&D protocol. Since standards are a public good, no country can be excluded from using them. Barrett imposes an open standards protocol, and accounts for competition which induces 'pull' incentives. In addition, the standards protocol is intended to be non-exclusionary in order to encourage the widespread adoption and diffusion of new technologies. In a subsequent work, Barrett (2002) proposes his technology-based international strategy as a means to promote technology transition in the electricity generation and transportation sectors. In short, five main components characterize this policy proposal: (1) an R&D protocol to 'push' the development of new technologies; (2) protocols establishing technology standards to provide a 'pull' incentive to commercialize new, low-emitting technologies; (3) a multilateral fund to help spread new technologies to developing countries; (4) a short-term system of pledge and

review; and (5) a protocol for adaptation assistance. This type of policy approach essentially aims at long-term technology transition. Benedick (2001) emphasizes that such a method could be effective in involving more countries in climate control efforts, and as the Montreal Protocol has shown, technology sets particularly strong incentives for developing countries to accept commitments.

Buchner et al. (2005) analyse a similar, but in substance still different, approach to increasing the number of participants in international climate efforts. They propose linking climate cooperation with technological cooperation in order to induce the US to move back to the Kyoto framework. The idea is that the incentives to benefit from appropriate R&D cooperation can only be obtained by cooperating on climate change control, and could offset the incentives to free-ride on the environmental dimension. This alternative approach, called 'issue linkage', is based on the idea that countries may have incentives to free-ride on a global public good, but these incentives become much smaller if negotiations on the global public good are linked with negotiations on another economic issue (typically a club good whose benefits cannot be reaped by free-riders). Buchner et al. (2005) explore this idea by firstly analysing what incentives the European Union, Japan and Russia have to adopt this issue linkage strategy, and then by examining the incentives for the US to join a coalition which cooperates both on GHG emissions control and on R&D investment and technology diffusion.

In addition to the above policy proposals, a number of suggestions have been made to provide financial assistance to countries for climate change control, all emphasizing the potentialities offered by technological change. During the negotiations on the Kyoto Protocol, several funds have been created, but given that they are all based on public money, it seems unlikely they will suffice in bringing about the radical changes needed in developing countries (Philibert, 2005b).[3] Furthermore, the creation of the so-called Green Investment Scheme (GIS) has been thoroughly discussed (see Blyth and Baron, 2003). This scheme is designed to increase climate action by providing fiscal advantages for investors in sustainable projects as well as to promote the environmental efficacy of transfers of excess assigned amount units (AAUs) arising from economies in transition (EITs).[4] In particular, the revenues from transactions that involve such surplus allowances should be earmarked for environmentally-related purposes in the seller countries, giving technology a central role once again (Korppoo, 2003). At the Sixth Session of the Conference of the Parties (COP 6) of the United Nations Framework Convention on Climate Change (UNFCCC) in November 2000, the Russian Federation formally introduced a proposal for a GIS.[5]

A significant support to the above policy proposals has recently been given by an important development in climate policy. In July 2005, six nations led by the US and Australia unveiled a complementary pact to the Kyoto Protocol, aimed at fighting global warming. The Asia-Pacific Partnership on Clean Development and Climate – signed by the US, Australia, Japan, China, India and South Korea – constitutes a voluntary, technology-based initiative to reduce greenhouse gas emissions without legally binding emissions targets, whose main idea is to develop new technologies and deploy these in developing countries. Other bilateral agreements on technology and climate change indicate the attractiveness of this strategy (see Buchner and Carraro, 2005a, and Philibert, 2005b, for a description of the main technological agreements). For example, in September 2005 the European Union and China agreed to strengthen cooperation and dialogue on climate change and energy issues, with a special focus on clean coal technology. Overall, the EU cooperates on international scientific policy with almost 30 countries[6] while the US is engaged in a large number of joint technology projects as well, having signed agreements for scientific and technological cooperation with 34 countries and the EU.[7]

5.2 THE ROLE OF TECHNOLOGICAL CHANGE AND R&D COOPERATION IN TOP-DOWN GLOBAL CLIMATE AGREEMENTS

The idea of a technology-based climate protocol is rooted on firm ground. The proliferation of international technology collaboration and in particular of bilateral agreements on climate technology cooperation would seem to indicate that the proposal for a technology-based climate protocol is worth serious consideration. This type of protocol could be established within the UNFCCC and could be a complement to, if not a substitute for, the Kyoto Protocol. Let us look in detail at the role of technical change in setting incentives to sign global agreements.

In a first step, we will investigate the role of technical change and R&D when it is used in the context of an issue linkage proposal. As briefly discussed above, technological cooperation could be linked to climate cooperation in order to increase the number of signatories to an international climate agreement. Let us now analyse whether R&D cooperation benefits, which can be obtained only through cooperation on climate change control, might offset the incentives to free-ride on environmental agreements made by other countries and thus constitute a sufficient incentive for the US to move back to the Kyoto framework. Using an integrated economy–climate optimal growth model, the FEEM-RICE model

(see section 5.3), Buchner et al. (2005) analyse both the incentives for the European Union, Japan and Russia to adopt this issue linkage strategy, and the incentives for the US to join a coalition which cooperates on GHG emissions control as well as on R&D investment and technological diffusion.[8]

The results reveal that the proposal to link R&D cooperation with cooperation on climate change control does carry weight, is profitable, and above all guarantees the stability of the linked agreement (no incentive to free-ride once the linked agreement is signed). In other words, if the issue linkage proposal is implemented, the participating countries benefit from cooperation even when the coalition-internal technological spillovers are modest. However, the issue linkage proposal is based on an implicit non-credible threat. Countries like the European Union, Japan and Russia prefer to cooperate with the US on technological innovation and diffusion even when the US free-rides on climate cooperation (see Buchner et al., 2005).

The intuition for this result is as follows. The benefits from technological cooperation are much higher for the EU, Japan, and above all Russia, than for the US. Therefore, the Annex B_{-US} countries suffer a bigger loss when the issue linkage threat is implemented, that is, when they exclude the US from the technological coalition. In addition, the environmental benefits arising from cooperation on climate change control are smaller, at least in the FEEM-RICE model, than the technological benefits from R&D cooperation. Therefore, the Annex B_{-US} countries prefer to lose the environmental benefits rather than the technological benefits, and thus accept the US free-riding on climate cooperation if the US cooperates on R&D.

Even though the issue linkage proposal is therefore unlikely to reinvolve the US in the Kyoto Protocol, the assessment of the issue linkage proposal based on technical change reveals a strong incentive for technological cooperation among Annex B countries.

Using again the FEEM-RICE model, we can also evaluate Barrett and Benedick's proposal of a technology-based protocol (see Barrett, 2001, 2002; Benedick, 2001). This approach is based on the idea of replacing international cooperation on greenhouse gas emissions control with international cooperation on climate-related technological innovation and diffusion. Although there is no doubt that the technology-based approach also has a number of weaknesses,[9] it does account for some of the crucial requirements needed to make an international climate regime successful: a global scale, strong elements for self-enforcement and a high degree of probability that the international system will support the approach. However, a basic trade-off characterizes the implementation of a technology-based climate protocol. On the one hand, technological innovation reduces emissions per unit of output by making climate-friendly technologies available

and by reducing their costs. On the other hand, investments in R&D and technological diffusion provide a stimulus to economic growth and therefore increase GHG emissions. This is particularly true in the absence of any emissions reduction targets, as proposed in Barrett (2001, 2002). It is therefore crucial to assess whether the adoption of a technology-based climate protocol can actually reduce GHG emissions, that is, whether the development of new technologies and their dissemination obviates the other collateral effects of the protocol.

Using two versions of the FEEM-RICE model (the first one including two types of international spillovers; the second one including a more sophisticated formulation of technical change, but no estimate of spillovers), we have attempted to verify whether cooperation on technological innovation and diffusion, without any emissions reduction commitments, could actually lead to a reduction of global emissions. Were this conjecture true, a technology-based climate agreement could actually be more efficient than a climate agreement based on emissions reduction targets, because the former provides excludable benefits – and thus adequate incentives for participation – while reducing the amount of GHG emissions. In addition, were the technological spillovers strong enough inside the coalition (the group of cooperating countries) and small enough outside the coalition (towards potential free-riders), then all world countries would be willing to adopt such a technology-based protocol. Our applied game-theoretic analysis focuses on two scenarios: the first one is characterized by technological cooperation among the four 'traditional' Kyoto countries/regions (the US, Europe, Japan, the Former Soviet Union), whereas in the second one all world countries, including developing countries, cooperate on technological innovation and diffusion. For each scenario, we evaluate profitability, stability (no free-riding incentives) and environmental effectiveness of technological cooperation in comparison to a 'Kyoto forever' scenario.[10]

Our results confirm the theoretical insights on the stability of technology-based climate regimes (see Buchner and Carraro, 2005a). In particular, as soon as the excludable benefits arising from technological cooperation become relevant ($\beta \geqslant 0.2$, that is, benefits for cooperators are 20 per cent higher than benefits accruing to free-riders), all countries find it profitable to cooperate. In addition, there is no incentive to free-ride on technological cooperation. The reason lies in the availability of economic benefits that can be appropriated only by coalition members. A technology-based regime is thus more stable than an emission-based regime, that is, more countries are likely to participate in the climate regime. In addition, technological cooperation without emission abatement commitments increases economic growth. Nonetheless, this strategy is unlikely to improve the environmental

effectiveness compared to the benchmark 'Kyoto forever' scenario, that is, a technology-based protocol does not seem to lower global GHG emissions. However, the increase in emissions is smaller when all world regions cooperate to develop and diffuse climate-friendly technologies than they would be if developing countries merely free-ride. Still, even though global cooperation increases the economic benefits and the environmental effectiveness of the agreement, total emissions in the technology-based protocol increase with respect to total emissions in the benchmark case. The hypothesis that a policy which fosters technological cooperation can also induce less GHG emissions is therefore not supported by these results. Technological cooperation will increase R&D, growth and welfare, but it will also increase emissions, and therefore would be no substitute for environmental cooperation.

This conclusion is however less cogent when using the version of FEEM-RICE that incorporates a more sophisticated representation of technological change. In this case, technical change is more effective in reducing carbon and energy intensity. In particular, in a situation of climate-friendly technological cooperation without emission targets, world carbon emissions actually decrease with respect to emissions in the 'Kyoto forever' scenario. Our results indicate that technological cooperation alone, without emission targets, could already stabilize concentrations at a level very close to 550 ppm. The line describing emissions in the case of technological cooperation without an emission target diverges only in the long run from the line describing emissions when the 550 ppm stabilization target is optimally achieved without technological cooperation. Therefore, cooperative technology development (independent of climate policies) drives the market in such a way as to both increase GDP and reduce GHG intensities (see Hanson et al., 2004; Velte et al., 2004). As a consequence, if countries cooperate on technological innovation and diffusion, 550 ppmv may become the new reference case, and the economy may be sufficiently strengthened to the extent that when the time arrives and climate issues inevitably emerge as a critical policy driver, there will be a significant shift in commitment and resources towards achieving an even smaller level of emissions.

Nonetheless, even when applying a very sophisticated representation of technological change, emissions are still larger when there is technological cooperation than they would be in the two cases in which an emission target is introduced. Therefore, establishing an emission target lowers emissions more than technological cooperation alone would do.

Notice that the role of R&D cooperation becomes less and less important as the stringency of the stabilization goal increases. For example, if a 450 ppm stabilization target is imposed, then technological cooperation may become redundant. The reason is that stringent stabilization goals

induce large R&D investments even in the absence of technological cooperation. This conclusion is also confirmed in Buchner and Carraro (2005b) who show a close relationship between future long-term commitments and present decisions on innovation and technical change. In particular, if emissions are to be much lower in the future, then the permit price increases strongly, because of the high future demand for emissions permits to meet future commitments. There exists a level of the permit price for which it is no longer optimal for countries to increase their demand for permits. Instead, investments in climate-friendly R&D become a more suitable strategy for coping with reduction requirements. Therefore, the higher the necessary future emissions reductions, the higher the expected compliance costs will be, and consequently greater investments in research and innovation will be required.

5.3 THE ROLE OF TECHNOLOGICAL CHANGE AND R&D COOPERATION IN BOTTOM-UP CLIMATE AGREEMENTS

The previous section has highlighted the role of technical change in the context of a global, top-down climate agreement. However, recent negotiations and policy developments suggest that it might be difficult to achieve a single global agreement, and that regional or sub-global agreements are more likely to emerge (see Buchner and Carraro, 2007; Egenhofer and Fujiwara, Chapter 3, this volume; Egenhofer and Legge, 2001; Victor, 2006). In this context, experiences from trade negotiations indicate a 'resurgence' of regionalism, underscored by the formation of competing customs unions and the debate about free trade areas.

Substantial attention has been paid to the efficiency and implications of these regional or sub-global cooperations. Recent developments consistently indicate that progress on trade liberalization can be achieved mostly through bottom-up, regional agreements, at least in the short term.[11] In addition, several authors have pointed out that regional trade agreements (RTAs) may seem to be contradictory, but they can often actually support the WTO's multilateral trading system (see Sampson and Woolcock, 2003).

Regional or sub-global agreements could also represent a first policy step towards tackling climate change, as is already happening partly in the context of the Kyoto Protocol. The basic idea is that a bottom-up, country-driven approach to defining national commitments can set higher incentives to participate in climate change efforts than national commitments based on top-down, international negotiations (see Buchner and Carraro,

2007). Let us therefore verify how effective technical change could be in increasing the incentives to participate in regional agreements, and what the implications for the formation of climate coalitions would be.

The analysis of the role of technical change in the context of regional climate agreements is carried out by using a modified version of Nordhaus's RICE model (see Nordhaus and Yang, 1996) in which endogenous and induced technical change are modelled. In our version of the model, known as the FEEM-RICE model (see Buonanno et al., 2002), technical change performs a twofold role: on the one hand, via increasing returns to scale, it yields endogenous growth; on the other hand, by affecting the emission–output ratio, it considers and conjectures the adoption of cleaner and energy-saving technologies.

In the model, six countries/regions (US, EU, Japan – JPN, the Former Soviet Union – FSU, China – CHN, and the Rest of the World – ROW) optimally set the intertemporal values of four strategic variables: investments, R&D expenditure, abatement effort and net demand for emissions permits.[12] When no coalition forms, each country/region maximizes its own individual welfare, given the other countries' strategies. Countries which belong to the same coalition maximize their joint welfare. Given the interdependency of countries' decisions, the equilibrium value of the control variables is the solution for a dynamic open-loop Nash game.

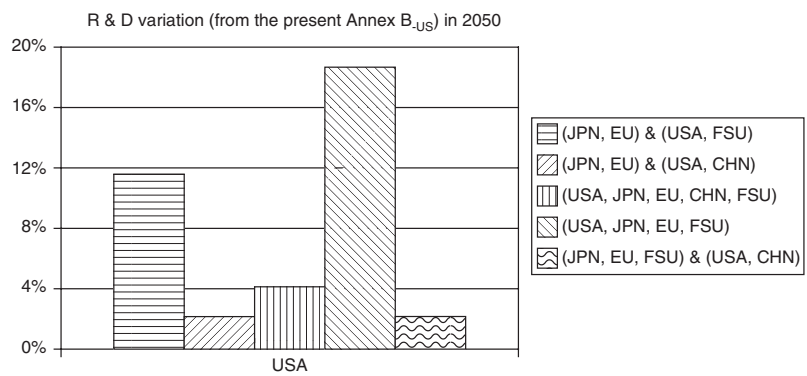
In addition to the model structure, three assumptions qualify our results.[13] First, all countries/regions which adhere to the Kyoto/Bonn agreement are assumed to meet their Kyoto target from 2010 onward.[14] We therefore adopt the so-called 'Kyoto forever' hypothesis (Manne and Richels, 1999). Our reference to the Kyoto/Bonn agreement is partly imprecise since, for the sake of brevity, we will at times call the 'Kyoto Protocol' or 'Kyoto/Bonn agreement' a 'Kyoto forever' scenario. Second, cooperating countries are assumed to adopt cost-effective environmental policies. In particular, cost-effective market mechanisms (for example emission trading) are chosen over 'command-and-control' measures in order to guarantee an efficient implementation of the environmental targets adopted within the coalition. Third, participation incentives will be assessed only in economic terms. There are several other political, cultural and environmental factors that can influence a country's decision to adopt a more effective climate policy, but they will not be addressed in this chapter. However, the economic dimension of climate negotiations is a key factor (and it has often been considered as the most important one in the US). Therefore, this chapter can provide a relevant, albeit partial, contribution to the analysis of the future evolution of international climate policy.[15]

Let us now analyse the importance of R&D in the context of various constellations of climate agreements, which have been derived by combining

economic factors and policy signals. In particular, we aim to find out how the role of R&D changes when different key players are involved in climate cooperation. Our focus is on post-2012 scenarios. We assume that a global agreement is only one of the possible outcomes of climate negotiations and that countries are also at liberty to form regional or sub-global agreements. We shall therefore consider situations in which countries that now belong to the Kyoto coalition may decide, in accordance with their own economic interests, to leave the Kyoto coalition and cooperate on GHG emission control with other countries/regions. The time horizon over which climate policy is optimized is 2010–2100.

5.3.1 The Role of Technological Change in the US

Given the key role of the US in any international efforts to combat climate change, let us start by analysing the implications on R&D when the US decides to start cooperating again in international climate policy. Domestic and international political reasons could induce the US to move back to climate negotiations in order to reap the benefits of low short-term abatement costs and to negotiate less demanding abatement targets in future commitment periods. The particular incentives that arise will be determined by the effect that different climate coalitions have on the US R&D sector, as highlighted by Figure 5.1.



Key: R&D = research and development; CHN = China; EU = Europe; FSU = Former Soviet Union; JPN = Japan.
Note: Five two-bloc regimes are analysed; for example (JPN, EU) and (USA, FSU) indicating a two-block coalition with a first coalition amongst Japan and Europe and a second coalition amongst the United States and the Former Soviet Union.

Figure 5.1 Changes of R&D investments in the US in various potential post-2012 climate regimes

Table 5.1 Implications of potential post-2012 climate regimes for key variables in the US in the year 2050

Coalition structures	R&D USA	Welfare USA	Total emissions
(USA, JPN, EU, FSU)	+18.67%	−17.35%	−9.71%
(JPN, EU) & (USA, FSU)	+11.59%	−13.58%	−9.71%
(USA, JPN, EU, CHN, FSU)	+4.13%	−9.46%	−17.90%
(JPN, EU) & (USA, CHN)	+2.16%	−6.10%	−8.12%
(JPN, EU, FSU) & (USA, CHN)	+2.16%	−6.05%	−17.90%

Key: R&D = research and development; CHN = China; EU = Europe; FSU = Former Soviet Union; JPN = Japan.

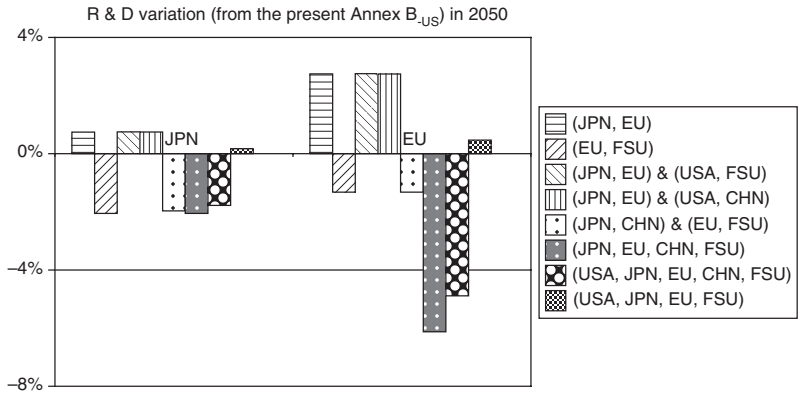
Notice how the highest incentives to invest in energy-saving technologies would emerge if the US cooperates with the EU, Japan and Russia on climate change control. This is the original Annex B coalition. The strict emissions target and the high abatement costs make a focus on R&D investments profitable, because energy-saving technologies would help countries to comply with their commitments. However, this coalition induces significant welfare losses for the US (see Table 5.1), which explains why the Americans withdrew from the Kyoto Protocol.

If the US and the FSU cooperate without the EU and Japan, who nevertheless remain committed to their Kyoto obligations, R&D is still very high in the US. The reason for this behaviour is that the US moves from a free-riding position (the current Annex B_{-US}) to climate cooperation, and therefore faces a real incentive to abate emissions. The overall environmental effectiveness is improved in this scenario, but the US still suffers significant welfare loss.

It is clear that the US is more likely to participate in a climate regime if its abatement costs – and correspondingly its welfare loss – are small. Such a situation becomes possible if the key developing countries cooperate on GHG emissions control. Table 5.1 shows that the US would incur more limited welfare losses if it could induce China to cooperate in a bilateral agreement. R&D investments would increase, even though less than in other climate regimes, because of the opportunity to exploit low abatement costs offered by the cooperation with China (a more detailed analysis of the US participation incentives and the role of China can be found in Buchner and Carraro, 2006).

5.3.2 The Role of Technological Change in the EU and Japan

Let us now analyse the role that R&D investments play for Japan and the EU, two countries which are part of the current climate regime. Both of



Key: R&D = research and development; CHN = China; EU = Europe; FSU = Former Soviet Union; JPN = Japan.

Figure 5.2 Changes of R&D investments in Japan and the EU in various potential post-2012 climate regimes

Table 5.2 Implications of potential post-2012 climate regimes for key variables in the EU and Japan in the year 2050

Coalition structures	R&D		Welfare		Total emissions
	EU	JPN	EU	JPN	
(USA, JPN, EU, FSU)	0.47%	0.17%	−1.07%	−1.47%	−9.71%
(JPN, EU, FSU) & (USA, CHN)	0.00%	0.02%	0.14%	0.16%	−17.90%
(JPN, EU)	2.74%	0.74%	−4.23%	−11.17%	+9.80%
(JPN, EU) & (USA, FSU)	2.75%	0.75%	−4.01%	−10.93%	−9.71%
(JPN, EU) & (USA, CHN)	2.74%	0.75%	−4.08%	−11.01%	−8.12%
(EU, FSU)	−1.32%	−2.05%	1.65%	10.93%	+3.40%
(JPN, CHN) & (EU, FSU)	−1.32%	−1.97%	1.68%	8.97%	−8.21%
(JPN, EU, CHN, FSU)	−6.13%	−2.05%	10.06%	10.84%	3.26%
(USA, JPN, EU, CHN, FSU)	−4.89%	−1.78%	4.69%	4.97%	−17.90%

Key: R&D = research and development; CHN = China; EU = Europe; FSU = Former Soviet Union; JPN = Japan.

them are buyers in the international emissions market, as they face relatively stringent targets and high abatement costs. Figure 5.2 and Table 5.2 show again the main implications of different coalition structures on these two countries, with a particular focus on the role played by R&D.

Figure 5.2 highlights that the pattern of R&D investments across different coalition structures is very much the same in the two countries. Both countries lose from a possible US decision to rejoin the current climate coalition, because demand would increase in the permit market. As a consequence, the permit price and abatement costs would be higher. In correspondence, incentives to invest in R&D would be higher in those regimes in which the US also joins the climate coalition.

Notice that both the EU and Japan suffer higher welfare losses if they remain alone in a bilateral agreement (see Table 5.2). Therefore, a potential defection by Russia in the second commitment period would set significant incentives to invest in energy-saving technologies, as achievement of the emissions targets would be more difficult.

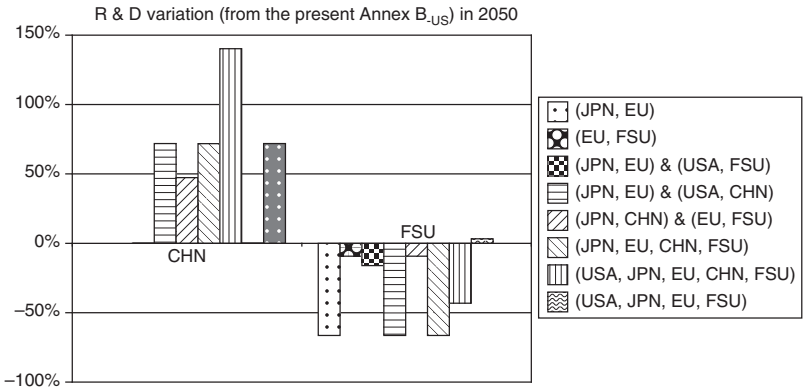
The possibility to cooperate with one of the key sellers in a bilateral emissions trading market instead enables considerable welfare gains to be made. The higher availability of low-cost abatement options induces Europe and Japan to reduce their R&D investments with respect to the current climate regime. In particular, the presence of China makes the achievement of emission reduction targets easier, as can be seen in the scenario in which the current Annex B_{-US} coalition is joined by China. This coalition structure provides the highest welfare gains for the EU and Japan, but would induce low investments in R&D. The participation by the US in this scenario would, on the other hand, lower welfare gains and increase R&D investments.

There is therefore a clear trade-off between developing countries' participation and investments in research and development. And there is a trade-off between the environmental effectiveness that the US participation would induce and the higher costs that this participation imposes on the EU and Japan.

5.3.3 The Role of Technological Change in Russia and China

Let us now analyse how the role of R&D changes when we look at the key sellers in a potential future global emissions trading market. Figure 5.3 and Table 5.3 summarize again the main implications of different coalition structures.

First of all, Figure 5.3 clearly shows that the two key sellers have opposing interests and contrasting R&D incentives across the different coalition structures. Russia and China compete to cooperate with the key buyers in the emissions trading market. As a consequence, they use R&D strategically. The R&D strategy of a market supplier can be described as follows. A key seller in the emissions trading market strategically overinvests in R&D in order to increase its sales. Indeed, increased investments in R&D would result in a higher supply of permits, which consequently leads to an



Key: R&D = research and development; CHN = China; EU = Europe; FSU = Former Soviet Union; JPN = Japan.

Figure 5.3 Changes of R&D investments in China and Russia in various potential post-2012 climate regimes

Table 5.3 Implications of potential post-2012 climate regimes for key variables in China and Russia in the year 2050

Coalition structures	R&D		Welfare		Total emissions
	CHN	FSU	CHN	FSU	
(EU, FSU)	−0.03%	−9.32%	−0.32%	−16.64%	+3.40%
(USA, JPN, EU, FSU)	0.03%	3.22%	0.32%	18.94%	−9.71%
(JPN, EU, FSU) & (USA, CHN)	71.87%	0.00%	−5.36%	0.00%	−17.90%
(JPN, EU) & (USA, FSU)	0.03%	−16.06%	0.32%	−18.17%	−9.71%
(JPN, EU) & (USA, CHN)	71.87%	−66.40%	−5.36%	1.79%	−8.12%
(JPN, CHN) & (EU, FSU)	47.32%	−9.32%	−10.08%	−16.64%	−8.21%
(JPN, EU, CHN, FSU)	71.83%	−66.40%	−5.67%	1.54%	3.26%
(USA, JPN, EU, CHN, FSU)	140.20%	−43.16%	13.86%	−19.71%	−17.90%

Key: R&D = research and development; CHN = China; EU = Europe; FSU = Former Soviet Union; JPN = Japan.

increase in the country's benefits from selling the permits in the permit market. However, this strategic use of R&D becomes less profitable when both China and Russia belong to the climate coalition.

Russia, which already participates in the current climate regime, will be adversely affected by the participation of China in the climate coalition (see

Table 5.3). Compare, for example, the scenario in which the current climate coalition is joined by the US with the situation where the US and China join the current climate coalition. In the former case, the entry of a large permit buyer provides relevant welfare gains to Russia. This induces higher strategic R&D investments in Russia, which finds it optimal to increase its supply of permits in order to maximize its profits in the permit market. Instead, when China also joins the coalition, Russia suffers some welfare losses (see Figure 5.3). Russia's welfare decreases because its revenues from selling permits decline due to the lower permit price caused by the larger supply to the market. As a consequence, Russia faces a lower incentive to undertake strategic R&D.

China benefits from participating in the climate coalition, because of its sales in the permit market, particularly when the US joins the coalition as well. China increases its R&D investments by 140 per cent in order to optimize its profits from selling permits. The remaining scenarios confirm that the possibility of increasing its profits through extensive strategic R&D investments enables China to find itself in a relatively profitable position, notwithstanding the move from free-riding to climate change cooperation.[16]

Therefore, when China participates in a climate coalition, R&D investments in developed countries become smaller, but increase in China. There is therefore a geographical redistribution of R&D investments across the various coalition structures.

5.4 CONCLUSIONS

Our analysis has highlighted that R&D investments play an important role in the formation of different sub-global climate coalition structures. In particular, R&D investments can provide relevant incentives for countries to participate in a cooperative effort to reduce GHG emissions. These incentives crucially depend on the structure of the climate coalition and the related emissions trading market. We have indeed shown that an increase in R&D investments increases the gains for permit sellers and reduces the costs for permit buyers.

In general, R&D enhances the participation incentives for permit buyers when the emissions target to be achieved becomes more stringent. Demanding abatement targets makes the development of low-cost abatement opportunities essential to achieve the target. This requires appropriate investments in climate-related R&D. These investments lower abatement costs and favour participation in a cooperative effort to reduce GHG emissions.

R&D enhances the participation incentives of permit sellers as well, in particular when they face a large emissions market (that is, with several

big buyers). In this case, permit-selling countries, by investing in R&D, can increase the amount of permits that they offer in the market. There is therefore a trade-off between developing countries' participation, usually the big permit sellers, and investments in research and development in developed countries. The more these countries invest in R&D, the more they reduce their own GHG emissions through technological change, and the less they demand permits in the permit market. This reduces the benefit for developing countries from signing a climate agreement based on cap and trade, and therefore their participation incentives.

Another implication of our analysis is that there is a trade-off between the environmental effectiveness that the US participation would induce and the higher costs that this participation imposes on the EU and Japan. If the US enters a global permit market, they increase the demand for permits and therefore the permit price. This increases the compliance costs for the EU and Japan and therefore stimulates their own investments in climate-related R&D.

Also notice that changes in the climate coalition induce a geographical redistribution of R&D investments. For example, when China participates in a climate coalition, R&D investments in developed countries, for example the EU or Japan, become smaller, but increase in China. When the US joins a coalition, it increases its own investments in climate-related R&D. But it also increases the demand for permits and the permit price, thus increasing abatement costs and investments in R&D also in the EU and Japan.

Finally, incentives to carry out climate-related R&D may be larger when a set of coalitions forms than when a global agreement is signed. In the multiple coalition case, abatement costs may be larger in each sub-coalition than in a global coalition (a sort of coalitional prisoners' dilemma), thus inducing more R&D investments. This may stimulate the development of new energy-saving or carbon-free technologies that may help in achieving those large reductions of GHG emissions that seem to be necessary to control climate change. Therefore, albeit inefficient from an economic viewpoint, an equilibrium with several parallel climate blocs may achieve larger emissions reductions than a global climate agreement.

NOTES

1. This chapter is part of the research work being carried out by the Climate Change Modelling and Policy Unit at Fondazione Eni Enrico Mattei. The authors are grateful to Igor Cersosimo and Carmen Marchiori for valuable research assistance and to Christian Egenhofer, Frank Convery and to the participants at the ESRI International Conference in Tokyo, 3–4 March 2005 for suggestions and remarks. Financial support from ESRI is gratefully acknowledged. The usual disclaimer applies.

2. See for example Barrett (2001, 2002), Benedick (2001), Edmonds (1999, 2002), Edmonds and Wise (1998), Edmonds et al. (2000), Flannery (2001), Jacoby (1998), Philibert (2004, 2005a, 2005b). The relative performance of technological innovation with respect to environmental policy tools is discussed in Parry et al. (2002).
3. For example, the Global Environment Facility (GEF) serves as the financial mechanism for the UN Framework Convention on Climate Change.
4. Given the special circumstances of economies in transition (EITs), these countries were allocated emissions commitments under the Kyoto Protocol that are sometimes well above their emissions in their chosen base year.
5. For a thorough discussion of this proposal see Tangen et al. (2002).
6. For more details see http://europa.eu.int/comm/research/iscp/countries.html.
7. A detailed description is provided on http://www.state.gov/g/oes/stc/
8. Note that the incentives to free-ride on the climate agreement come from the public good nature of climate change control, whereas the incentives to free-ride on the R&D agreement arise from the presence of technological spillovers. Therefore, R&D cooperation is assumed to be an imperfect club good. In order to capture the idea that countries which do not belong to the R&D coalition are excluded from the benefits produced by R&D cooperation, a new parameter is added to the standard FEEM-RICE model, denoted by β. This parameter quantifies the increased share of world knowledge which is appropriated by countries belonging to the R&D coalition. This parameter is equivalent to the 'differential technological spillover' or 'coalition information exchange coefficient' in the theoretical model by Carraro and Siniscalco (1995, 1997).
9. For example, there are problems in ensuring that the 'right/best' standards are chosen and that the adoption of these standards indeed offers every participating country a benefit in excess of the cost. An additional question is who will choose the standards. A further concern is that the system gets locked in to a particular standard which would remove the incentives for further innovation.
10. This scenario assumes that all the Kyoto countries ratify the treaty and comply with their emissions targets from 2010 onward (see Buonanno et al., 2002; Manne and Richels, 1999; and Chapter 8 of IPCC, 2001). It is not necessarily the best one, but it is certainly not very ambitious in terms of emissions abatement. If GHG emissions in a technology-based regime are larger than in the 'Kyoto forever' scenario, then they are going to be larger than in other more ambitious and more important stabilization scenarios as well.
11. The strong increase in the number of trade bloc agreements registered with the World Trade Organization is discussed in Tjornhom (2000) and Boonekamp (2003).
12. Note that, in all climate regimes, abatement is a strategic value which is optimally set at its welfare-maximizing level.
13. Please note also that our analysis focuses only on CO_2. There are other man-made greenhouse gases and the Kyoto Protocol takes some of them into account. Moreover, both the Bonn agreement and the subsequent Marrakesh deal emphasize the role of sinks in meeting the Kyoto targets. As shown by several recent analyses (for example Manne and Richels, 2001; Jensen and Thelle, 2001), the inclusion of the other greenhouse gases and of sinks would further reduce mitigation costs.
14. The use of the 'Kyoto forever' hypothesis may be seen as a strong assumption. However, the CO_2 concentration levels implicit in this assumption (if FEEM-RICE is a good description of the world) coincide with those in the A1B scenario (see Chapter 2, this volume) (IPCC, 2001) which can be considered the 'median' scenario among those currently proposed. We thus use the 'Kyoto forever' hypothesis not because it represents a realistic scenario, but as a benchmark with respect to which policy alternatives can be compared.
15. For a discussion of the political factors behind the role played by China and the US in climate policy negotiations see Zhang (2004).
16. Let us however stress that China's abatement target in our analysis is close to the business-as-usual (BAU) scenario. We assume that China agrees to a 10 per cent reduction of emissions with respect to the BAU scenario over the whole time horizon.

REFERENCES

Ausubel, J.H. (1995), 'Technical Progress and Climatic Change', *Energy Policy*, **23** (4/5), 411–16.

Barrett, S. (2001), 'Towards a Better Climate Treaty'. *Policy Matters* 01-29, Washington, DC: AEI-Brookings Joint Center for Regulatory Studies.

Barrett, S. (2002), *Environment and Statecraft*, Oxford: Oxford University Press.

Benedick, R.E. (2001), Striking a New Deal on Climate Change, *Issues in Science and Technology*, Fall, 71–6.

Blyth, W. and R. Baron (2003), 'Green Investment Schemes: options and issues', OECD/IEA, COM/ENV/EPOC/IEA/SLT(2003)9.

Boonekamp, C. (2003), 'The changing landscape of RTAs', WTO Secretariat, Trade Policies Review Division, prepared for the Seminar on Regional Trade Agreements and the WTO, WTO Secretariat, Geneva, 14 November.

Buchner, B. and C. Carraro (2005a), 'Economic and environmental effectiveness of a technology-based climate regime', *Climate Policy*, **4**, 229–48.

Buchner, B. and C. Carraro (2005b), 'Modelling climate policy: perspectives on future negotiations', *Journal of Policy Modeling*, **27** (6), 711–32.

Buchner, B. and C. Carraro (2006), 'US, China and the economics of climate negotiations', *International Environmental Agreements: Politics, Law and Economics*, **6** (1), 63–89.

Buchner, B. and C. Carraro (2007), 'Parallel climate blocs: incentives to cooperation in international climate negotiations', forthcoming in R. Guesnerie and H. Tulkens (eds), *The Design of Climate Policy*, Cambridge, MA: MIT Press.

Buchner, B., C. Carraro, I. Cersosimo and C. Marchiori (2005), 'Back to Kyoto? US participation and the linkage between R&D and climate cooperation', in A. Haurie and L. Viguier (eds), *Coupling Climate and Economic Dynamics*, Dordrecht: Kluwer Academic Publishers.

Buonanno, P., C. Carraro and M. Galeotti (2002), 'Endogenous induced technological change and the costs of Kyoto', *Resource and Energy Economics*, **524**, 11–35.

Carraro, C. and D. Siniscalco (1995), 'Policy coordination for sustainability: commitments, transfers, and linked negotiations', in I. Goldin and A. Winters (eds), *The Economics of Sustainable Development*, Cambridge: Cambridge University Press.

Carraro, C. and D. Siniscalco (1997), 'R&D cooperation and the stability of international environmental agreements', in C. Carraro (ed.), *International Environmental Agreements: Strategic Policy Issues*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.

Edmonds, J.A. (1999), 'Beyond Kyoto: toward a technology greenhouse strategy', *Consequences*, **5** (1), available at: www.gcrio.org.

Edmonds, J.A. (2002), 'Atmospheric stabilisation: technology needs, opportunities, and timing', in D. Kennedy and J.A. Riggs (eds), *US Policy and the Global Environment: Memos to the President*, Aspen, CO: Aspen Institute.

Edmonds, J., J.M. Roop and M.J. Scott (2000), 'Technology and the economics of climate change policy', prepared for the Pew Center on Global Climate Change, Batelle, Washington, DC.

Edmonds, J. and M. Wise (1998), 'Building backstop technologies and policies to implement the Framework Convention on Climate Change', Pacific Northwest National Laboratory, Washington, DC.

Egenhofer, C. and T. Legge (2001), 'After Marrakech: the regionalisation of the Kyoto Protocol', CEPS Commentary.
Flannery, B.P. (2001), 'Alternative climate proposals: an efforts-based approach, Exxon Mobil cooperation', presentation prepared for the International Conference on Climate Policy – Do We Need A New Approach? Venice, 6–8 September.
Hanson, D.A., I. Mintzer, J.A. Laitner and L.J. Amber (2004), 'Engines of Growth: Energy Challenges, Opportunities, and Uncertainties in the 21st Century', Argonne, IL: Argonne National Laboratory.
IPCC (2001), *Third Assessment Report*, Cambridge: Cambridge University Press.
Jacoby, H.D. (1998), 'The uses and misuses of technology development as a component of climate policy', MIT Report No. 43, MIT Joint Program on the Science and Policy of Climate Change.
Jensen, J. and M.H. Thelle (2001), 'What are the gains from a multi-gas strategy?' FEEM Working Paper 84.01, Milan.
Korppoo, A. (2003), 'Forging alliance with Russia: the example of a Green Investment Scheme', *Climate Policy*, **103**, 1–10.
Kypreos, S. (2005), 'Impacts of RD&D on carbon mitigation cost', presentation at the IMCP Workshop in Berlin, Germany, 23–24 February, Paul Scherrer Institute.
Manne, A. and R. Richels (1999), 'The Kyoto Protocol: a cost-effective strategy for meeting environmental objectives?' in J. Weyant (ed.), *The Cost of the Kyoto Protocol: A Multi-Model Evaluation*, Special Issue of the *Energy Journal*.
Manne, A.S. and R. Richels (2001), 'US rejection of the Kyoto Protocol: the impact on compliance costs and CO_2 emissions', Working Paper 01-12, AEI-Brookings Joint Center for Regulatory Studies.
Nordhaus, W.D. and Z. Yang (1996), 'A regional dynamic general-equilibrium model of alternative climate-change strategies', *American Economic Review*, **4**, 741–65.
Pacala, S. and R. Socolow (2004), 'Stabilization wedges: solving the climate problem for the next 50 years with current technologies', *Science*, **305**, 968–72.
Parry, I.W.H., W.A. Pizer and C. Fischer (2002), 'How large are the welfare gains from technological innovation induced by environmental policies?' RFF Discussion Paper 02-57, Washington, DC.
Philibert, C. (2004), 'International energy technology collaboration and climate change mitigation', IEA/OECD, COM/ENV/EPOC/IEA/SLT(2004)1.
Philibert, C. (2005a), 'Energy Demand, Energy Technologies and Climate Stabilisation', *Proceedings of the IPCC Expert Meeting on Industrial Technology Development, Transfer and Diffusion*, held in Tokyo, 21–23 September 2004, Bilthoven, The Netherlands: IPCC Working Group III Technical Support Unit.
Philibert, C. (2005b), 'The role of technological development and policies in a post Kyoto climate regime', *Climate Policy*, **5** (3), 291–308.
Sampson, G. and S. Woolcock (2003), *Regionalism, Multilateralism, and Economic Integration. The Recent Experience*, Tokyo: United Nations University Press.
Sijm, J.P.M. (2004), 'Induced technological change and spillovers in climate policy modelling: an assessment', ECN-C-04-073, October, Petten, The Netherlands: ECN.
Tangen, K., A. Korppoo, V. Berdin, T. Sugiyama, C. Egenhofer, D. Drexhage, O. Pluzhnikov, M. Grubb, T. Legge, A. Moe, J. Stern and K. Yamaguchi (2002), 'A Russian Green Investment Scheme: securing environmental benefits from

international emissions trading', *Climate Strategies*, http://www.climate-strategies.org/gisfinalreport.pdf.
Tjornhom, J. (2000), 'Dynamic trade bloc formation: building blocs or stumbling blocs?' University of Minnesota.
Velte, D., J.P., Lopez de Araguas, O. Nielsen and W. Jörß (2004), 'The EurEnDel Scenarios: Europe's Energy System by 2030', Berlin: EurEnDel.
Victor, D. (2006), 'Fragmented carbon markets and reluctant nations: implications for the design of effective architectures', paper presented at the international workshop on Architectures for Agreement: Addressing Global Climate Change in the Post-Kyoto World, Harvard University, 12–13 May.
Yi, S. (1997), 'Stable coalition structures with externalities', *Games and Economic Behavior*, **20**, 201–23.
Zhang, Z.X. (2004), 'Climate change policy' (comment on 'Practical climate change policy' by Richard B. Steward and Jonathan B. Wiener), *Issues in Science and Technology*, **20** (3).

6. Bottom-up approaches to climate change control: some policy conclusions

Carlo Carraro and Christian Egenhofer

Climate change control is a public good and, as is well known, the provision of public goods is fundamentally undermined by a free-riding problem. A global agreement to reduce greenhouse gas (GHG) emissions is therefore very unlikely. In addition, in the case of climate change control, the presence of large asymmetries among countries and of important uncertainties on the impacts of climate change, the long time horizon and the consequent crucial role of the discount factor, and the presence of irreversibilities, reduce even further the probability of achieving a global climate agreement. This is why actors in the climate negotiation process should pay more attention to the basic incentives that countries face when negotiating on future strategies to reduce GHG emissions. As discussed in Chapter 2 of this book, these incentives do not lead to a global agreement, but rather to a set of regional or local or sub-global partial agreements. This analytical conclusion is consistent with the recent evolution of negotiations on climate change control and is also consistent with negotiations on other important issues like free trade (Chapter 4) and European integration (Chapter 3).

Then the main questions of this book. Can these regional or sub-global agreements effectively reduce GHG emissions? Is this reduction sufficient to control climate change? How can regional or, more generally, sub-global agreements contribute to reach a global agreement?

The previous five chapters of this book could not answers all the above questions. Nevertheless, they provide some important insights on the environmental and economic consequences of a fragmented climate regime, in which several regional or sub-global agreements are signed. They also analyse whether these regional agreements can be the building blocks of a more environmentally effective, global agreement. The overriding theme of the book is indeed to analyse whether regional or sub-global agreements can enhance the incentives to participate in a global climate regime. It does so by taking different perspectives. It brings together international relations

theory, which has a strong focus on self-interested behaviour and institutions, with the economic literature, which in this book has a strong focus on international environmental agreements. Chapter 1 has set out this context.

Chapter 2 explicitly deals with the economic and environmental consequences of some regional and sub-global climate regimes. Rather than focusing on issue linkage, transfers or burden sharing as tools to enhance the incentives to participate in a climate agreement, Chapter 2 explores the economic implications of a different policy architecture in which each country has the freedom to sign agreements and deals, bilaterally or multilaterally, with other countries, without being constrained by any global protocol or convention. This chapter therefore analyses the possible welfare and technological consequences of different multiple bloc climate regimes. Their overall environmental effectiveness is also discussed. The main conclusion is that there is no incentive to sign a global agreement and that even several partial sub-global coalitions are not likely. Indeed, a move from the current climate change regime, characterized by a single partial coalition formed by the so-called Kyoto countries, can hardly be envisaged, at least in the short term. The US, which does not participate in the Kyoto Protocol, is more likely to adopt domestic climate change control policies than to join an international agreement. The EU and Japan would see their abatement costs increased by a participation of the US in a global permit market. And Russia would oppose the participation of China. Therefore, there is little incentive to move from the present climate regime. However, this regime is largely ineffective from an environmental viewpoint, namely because GHG emissions are only slightly reduced under the Kyoto Protocol. Therefore, a move towards a more environmentally effective climate regime would be welcome.

Chapter 2 explores the costs and benefits of some possible alternative regimes. Given the strong incentives to form some parallel climate coalitions, rather than a single global agreement, the chapter focuses on three regimes characterized by multiple agreements. The main conclusion is as follows. If, for political reasons, the US decides to cooperate on climate change control, the climate regime with the lowest economic costs for the negotiating countries is the one in which China and the US cooperate bilaterally, and the current industrialized countries under the Kyoto Protocol form a parallel agreement. This regime would also provide the largest emission abatement (at least amongst the coalition structures analysed in Chapter 2). Therefore, there are reasons to suggest that, if a change occurs, two parallel agreements may emerge in the near future. The question is then: can these two parallel agreements converge to a global one?

This question has been addressed in Chapter 3 by looking at recent EU experiences. Chapter 3 examines whether and under what conditions the

specific form of a bottom-up approach – regionalism or European regional integration – can be an important complement to top-down approaches to the creation of a global climate change regime. The principal finding of this chapter is that bottom-up approaches including various forms of regional and non-regional cooperation can work. However, they support rather than replace institutional frameworks built in a top-down manner. Another important result is that, strictly from the EU experience, it appears that regional integration may have the biggest impact regarding implementation of (climate) policies (that is, to reduce emissions) and is somewhat less important *vis-à-vis* negotiations, that is, agreeing internationally on legally binding commitments. Chapter 3 shows that strategic issues to which a climate change agreement should be counted tend to be discussed and settled by bilateral negotiations. Despite EU attempts to set out common objectives for a number of countries, typically from the same region, in reality EU approaches often remain tailor-made and differentiated with some adjustments on a case-by-case basis. Over time the EU model has increasingly highlighted differentiation or progressive engagement to accommodate for differences of countries. Sub-global arrangements that the EU pursues have become useful tools to widen the scope for possible trade-offs and facilitate issue linkages with climate change. Nevertheless, ultimately this should increase over time the chances of a broader, if not global agreement. Hence, based on EU experiences with sub-global arrangements, what we should expect at best from international negotiations is improved policy coordination instead of a fully fledged international agreement. Such policy coordination over time may become an important stepping stone towards a global agreement.

In the same way as Chapter 3 did for the EU, Chapter 4 has attempted to draw lessons for climate change from international trade, an area which has seen a shift from multilateral to regional trade agreements. Progress towards global agreements has slowed down and at the same time regional initiatives have emerged at an increasing pace. The basic conclusion is that trade liberalization does not necessarily have to be undertaken at the multilateral level. Regional and even sub-regional initiatives have proven, in some circumstances, to contribute to trade liberalization. Or put differently, there is no evidence that regional or sub-regional initiatives undermine multilateral processes. On the contrary, there has been an argument that especially multilateral complexities can be reduced by regional trade agreements. This could hold lessons for climate change as well, where complexities are even bigger than in trade. More generally, regional trade agreements have gone beyond the WTO in incorporating many of the 'new issues' that have been so controversial at the WTO, such as regulating government procurement, investment, intellectual property rights, competition

and services – as well as the environment. If trade negotiations can hold a lesson, it is that controversial issues have been resolved more easily at regional than at global level. Hence, the conclusion is that the fear of 'regulatory regionalism' does not seem to be well founded and regional agreements could reasonably be expected to represent a stepping stone towards multilateral agreements, rather than being a serious impediment.

Chapter 5 deals with participation incentives and technological change and asks whether strategic incentives exist to invest in R&D and innovation to enhance the benefits from participating in a climate coalition. Closely linked is the question on what kind of coalition is best suited to favour R&D investment. The chapter adds a new dimension to the analysis of the linkages between technical change and climate policy, with a focus on regional and sub-global climate regimes or coalitions and how the formation of these coalitions both affects and is affected by technological change. By bringing R&D into the equation, the chapter equates a climate change agreement more to a trade agreement. The chapter finds that R&D investments play an important role in the formation of different sub-global coalitions. In particular, R&D investments can provide incentives for participation in a cooperative approach, that is, an international agreement. But the study also identifies several trade-offs. The first is between developing countries' participation and investment in R&D. Assuming that developing countries generally have a less stringent target and lower marginal abatement costs, the participation of these countries reduces overall abatement costs in developed countries and thus the incentives to invest in climate-related R&D. The second is between the environmental effectiveness of US participation and higher compliance costs for other industrialized countries. Finally, and not surprisingly, changes in the climate coalition induce geographical redistribution of R&D investment. For example, when China participates in a climate coalition, R&D investments in developed countries become smaller, but increase in China.

The above results, that briefly summarize the main analytical conclusions of the previous five chapters of this book, can also be used to develop some policy conclusions. They can be phrased as follows :

- From the analysis of individual countries' incentives and taking into account countries' asymmetries, this book confirms that the emergence of different climate change sub-global agreements is likely, but also that such sub-global agreements are likely to emerge quicker than a global agreement would. This supports the idea of a bottom-up approach to climate policy by stressing that endogenous forces may lead to cooperation, but that this cooperation is likely to take place at the sub-global or regional level.

- One of the lessons from trade negotiations is that sub-global approaches can support global efforts, depending however on the circumstances. Trade negotiations furthermore hold the lesson that controversial issues can be resolved more easily at regional than at global level. Hence, the fear of 'regulatory regionalism' does not seem to be well founded and regional agreements could reasonably be expected to represent a stepping stone towards larger, possibly global, agreements.
- The EU study reveals that sub-global agreements are a good tool to implement coordinated national policies, but that they are less suitable instruments to agree on internationally legally binding commitments, which by definition reduce national sovereignty. Regional or sub-global agreements find their limits when it comes to strategic issues with global reach such as security of energy supply or climate change. It seems unavoidable that ultimately such strategic issues have to be settled by bilateral or if needed, as in the case of climate change, by multilateral agreements.
- R&D investments play an important role in the formation of different sub-global coalitions. In particular, R&D investments can provide incentives for participation in an international agreement. However, policymakers should pay attention to some important trade-offs. The first is between developing countries' participation and investment in R&D. In the case of non-participation of developing countries, the level of R&D spending in developed countries is higher. The second is between the environmental effectiveness of US participation and higher compliance costs for other industrialized countries. Finally, changes in the climate coalition alter the geographical redistribution of R&D investments. Participation of fast-growing and big developing countries such as China and India is likely to attract significant R&D investments and crowd out similar investments in developed countries.

Summing up, a global agreement is unlikely to be signed by all the relevant countries. Several parallel agreements are going to emerge over time. Domestic measures and/or policies implemented by small groups of countries are going to be adopted to control climate change. Nevertheless, this initial fragmented climate regime should not be seen as an obstacle to a global agreement. By focusing on economic incentives, our analysis suggests that, despite the initial difficulties, the process towards a global agreement may be successful. And that a set of regional agreements can be the building blocks of an environmentally effective and economically efficient global agreement.

Index