

The Design of Climate Policy

edited by Roger Guesnerie and
Henry Tulkens

 Seminar Series

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Synopsis of the Book

Roger Guesnerie and Henry
Tulkens

This book comes as the proceedings of a conference on “The Design of Climate Policies,” held at the Venice Summer Institute of CESifo on July 22 and 23, 2005. David Bradford had initially accepted our invitation to give a keynote lecture to the conference. When we learned of his tragic death on February 22, we decided to have his paper read by one of us at the conference as a tribute to him.

The papers are gathered here in four parts, with the unity of each part characterized by the content and/or style. The first two parts are concerned with the conditions for a fruitful international cooperation on climate policies. The papers in part I focus on appropriate institutions for an efficient collective action. The papers in part II deal with the theoretical and practical questions of cohesion of the international community. The papers in parts III and IV bring to the discussion theoretical dimensions (part III) and quantitative tools (part IV) of climate policy design.

Overview of The Chapters

Part I presents the framework within which climate policies are implemented. The opening chapter 2 is the unpublished piece that we had asked David Bradford to contribute for the conference.¹ David presents a proposal for international cooperation that substantially differs from that of the Kyoto agreement. Chapter 3 by Roger Guesnerie has a closely connected theme. Roger begins with comments on David Bradford’s proposal, and then revisits the main issues underlying the design of efficient international institutions on climate policies. In chapter 4 Sushama Murty offers her own theoretical insights on the two preceding chapters. Chapter 5 by Jean-Charles Hourcade, P. R. Shukla, and Sandrine Mathy examines the involvement of less developed

countries (LDCs) in climate policies and puts the economic viewpoint in a broader political perspective.

Part II puts emphasis on the logic of coalition formation and discusses the stability of international environmental agreements. This is a subject that calls for a game-theoretic analysis. Chapter 6 by Johan Eyckmans and Michael Finus proposes two types of measures to enhance the success of international environmental treaty-making. Chapter 7 by Barbara Buchner and Carlo Carraro assesses the empirical plausibility of emergence of a single or of multiple climate coalitions. Chapter 8 by Parkash Chander and Henry Tulkens take these issues to a more general level and critically review the various notions of stability and related concepts used in the game-theoretic literature on international environmental agreements. Chapter 9 by Sylvie Thoron wraps up this debate.

Part III is devoted to issues of policy design at a general level. In chapter 10 William Pizer pleads for a less ambitious and more decentralized approach to international cooperation in climate affairs than the one currently pursued by the United Nations in the Framework Convention and the Kyoto Protocol. He warns of the multiple dimensions of the design of internal policies. Richard Tol offers his views on these issues in chapter 11. Next specific policy issues are put under theoretical scrutiny, namely in order of appearance: the choice of policy targets, the intertemporal aspects of carbon trade, and the optimal implementation of a sequestration policy. In chapter 12 Ian Sue Wing, A. Denny Ellerman, and Jaemin Song compare absolute and intensity limits for carbon dioxide emission control. They show how these two instruments, although equivalent in a certain world, differ when their performance is under conditions of uncertainty. In chapter 13 Katrin Redhanz and Richard Tol consider how successive permit allocation rules create incentives that accelerate or decelerate emission reduction paths. Chapter 14 by Gilles Lafforgue, Bertrand Magné, and Michel Moreaux, which has been added to the selection of papers presented to the conference, provides an original timing analysis of a sequestration policy that implements a ceiling on the stock of carbon in the atmosphere.

The chapters gathered in part IV take up policy design as well but include elaborate quantitative examinations. In chapter 15 Philippe Ambrosi uses a stochastic optimal control model to evaluate the effect of a constraint on the rate of temperature change for the determination of policies. In chapter 16 Damien Demailly and Philippe Quirion

present simulations of a spatial international trade model to discuss leakages from climate policies and border tax adjustments in the cement industry. In chapter 17 Stéphane De Cara, Elodie Galko, and Pierre-Alain Jayet examine how to correct the shortcomings of the standard Global Warming Potential index used for greenhouse gases.

Transversal Debates

We now attempt to put the different contributions in the transversal perspective of some key debates of climate policies. The debates that we single out have their roots in the present situation and refer to the real or imaginary shortcomings of the Kyoto Protocol. We consider two of them: the first refers to *the feasible and desirable extent of international cooperation on climate policies*, and the second to *the optimal effort and the optimal timing of climate policies*.

The existing situation is characterized by a non-unanimous involvement of rich countries and, in the background, the syndrome of US nonratification and a very limited involvement of LDCs. This situation seems particularly detrimental to the effectiveness of the present climate scheme. Indeed, the search for a formula triggering both the participation of all developed countries and the voluntary participation of LDCs has stimulated reflection. This is indeed the preoccupation at the heart of David Bradford's proposal, that we referred to as Global Public Good Purchase (GPGP) as well as in Guesnerie's discussion of post-Kyoto schemes. Under GPGP the public good provision relies on voluntary contributions from developed countries. But an international Bank uses the collected funds to buy emission abatements all over the world. As the emission allowances involve all countries and are set up at a business as usual level, the scheme is expected to trigger participation of all countries, including LDCs. Related mechanisms, nonbinding quotas, might also similarly trigger participation in post Kyoto schemes. However, the present failure to organize what game theorists call a "grand coalition" has led to reflections in different directions.

First, one may see the present situation as reflecting political constraints that have to be taken into account, and therefore adopt a second-best (or third-best) viewpoint. This is a possible reading of the contribution by Hourcade, Shukla and Mathy (chapter 5): in the present context, they look at realistic policies that may reconcile ambitious development objectives with the use of less carbon-intensive technologies in LDCs. A second possible reading of their paper is that without

rejecting a “grand plan” à la Kyoto that they may find necessary, they certainly do not find such a “grand plan” sufficient. They plead, for example, for regional cooperation in South Asia, where wider energy trade could both bring more growth and substantial carbon savings.

Pizer (chapter 10) takes a more radical viewpoint and sees intrinsic merits to the present fragmentation. Arguing that an international agreement is not necessary to initiate relevant domestic action on climate change, he is doubtful about the value of international emissions trading at the present stage and favors the heterogeneity of carbon prices across the world.

Does this position reflect some Leibnizian optimism, “tout est pour le mieux dans le meilleur des mondes,” as Voltaire had mocked it?² No answer can be given without delving into questions of feasibility and desirability: Is a global arrangement between nations feasible, is it desirable?

A starting point to the debate may be found in Buchner and Carraro’s argument (chapter 7) that a two-coalition structure—consisting, on one side, of Japan, the European Union, and the former Soviet Union, and on the other side, China and the United States—is politically plausible (although lacking “stability” in both senses to be made clear below), and can improve upon the present fragmented situation for some countries (Japan and the European Union). Eyckmans and Finus (chapter 6) explore more closely the issue of internal and external stability of alternative coalition structures, and whether transfer rules and/or alternative institutional rules as to coalition membership can enhance such stability properties. The answers they provide, based on simulations of a particular numerical model, are often positive, but they do not imply that this kind of stability can be ensured for the coalition of all countries.

In any case, the stability concept under scrutiny is partial. Indeed, for the world considered in these game-theoretical models, the associated game has side payments, and in technical terms is superadditive so that a global arrangement is in a sense always desirable. This means in particular that if the world is split into disjoint coalitions, as it is in Buchner and Carraro (chapter 7), or in any other of the coalition structures considered by Eyckmans and Finus (chapter 6)—other than the coalition of all countries—there does always exist merging plans advantageous for all countries. One such merging plan is the Chander and Tulkens scheme that rests upon the alternative game-theoretical stability concept of the “core” of a cooperative game. Can we therefore conclude that the grand coalition will form?

A first and mostly positive insight is provided by the fact that for the merging plan to be made mutually advantageous, the scheme rests on a formula specifying lump-sum transfers between nations. Now, experience shows that there exists very few examples of explicit transfers between nations. However, is it not the case that in the present context, transfers can be mimicked by changes of quotas? Diminishing the quota of a country while augmenting the quota of another country is like implementing a lump-sum transfer from one country to the other. In chapter 8 (note 12), Chander and Tulkens remind us that, according to their early interpretation of the Kyoto Protocol, this possibility is clearly opened by the “cap and trade” architecture. Yet one may conceivably argue that the extent to which quotas differentiation has been actually used in the Protocol does substantially underscore the amount of transfers required for the sustainability of a core-like stable agreement.

A second argument, apparently negative, is that the core-stable grand coalition may itself be unstable in the internal-external sense. This issue is dominated by the fact that the quality of the climate is a nonexcludable public good: if a nation defects from a global arrangement, either it will still benefit from the effort of the remaining countries if these stick to the agreement, or it will not get any benefit if its defection also entails the defection of these other countries from the global arrangement; in the latter instance, the country realizes that it cannot get any gain from defecting. What the chapter by Chander and Tulkens in this book makes clear is that the alternative just described corresponds to the two stability concepts involved: internal-external stability versus core stability. They may be compatible, but they also may not be, as shown by some simulations of Eyckmans and Finus.

The stability issue thus appears not to be a straightforward one. Also it is more intricate than what is suggested by the simple game-theoretic model under scrutiny in the three chapters just discussed. Therefore let us consider now some directions of complexification in the analysis of stability and fragmentation.

First, the basis of the aggregate models used may be discussed. On the one hand it may be the case that, contrary to what is permitted in the simpler game-theoretic setting, large lump-sum transfers, or their counterpart—wide quota differentiation—are not possible in real world negotiations. On the other hand, the analyses of stability in these models are static ones,³ while the problem is essentially a dynamic one due to the phenomenon of carbon accumulation. While theoretical developments have occurred in that direction,⁴ the way in which their

results can enrich the interpretations of the Kyoto Protocol remains to be further explored.

Third, the level of aggregation itself may be questioned. It is clear for example that the uniqueness of carbon price assumed in aggregate models will not be reflected at the disaggregate level in real world arrangements. This is clear from the Kyoto scheme itself: even with a world market for quotas, individual countries have a lot of freedom in the determination of internal policies and in the role they give to the world price signal. Hence flexible internal policies, as advocated by Pizer (chapter 10), may not be as incompatible with a strong cooperative agreement as one often believes.

Heterogeneity of carbon prices, however, raises questions that may be the more serious, the less cooperative the choice of internal policies are. The most obvious question is that heterogeneity of carbon prices affects the conditions of international exchange in a way that, in the Kyoto case, is detrimental to the virtuous countries and weakens the return of their effort. This point, made in qualitative terms in Guesnerie (chapter 3), is at the heart of the empirical analysis of Demailly and Quirion (chapter 16). They show, from a detailed model of the cement industry, that imposing in annex-B countries a carbon price of 15 euros per ton of CO₂ leads to a 20 percent internal abatement, but with a significant "leakage" effect on other countries, even though such a leakage might be attenuated or even suppressed with a border tax adjustment.

While the stability discussions raised here bring the trade issue into the picture, it is worth noting that some of the questions previously raised, for example by Pizer (chapter 10), already had a trade flavor or at least counterparts in the discussion of the merits and benefits of international trade: What is a mutually advantageous arrangement that leaves enough freedom and space for the internal policies?

Going one step further, one might wonder why so ambitious an international arrangement on the environment as the Kyoto Protocol should treat the environment separately from trade, and why a deal connecting both fields might not be better. Unless one adopts an arrangement such as Bradford's (chapter 2) that implements a world carbon price and thereby solves simultaneously the problems of participation and "fair competition," the issue of linking environment and trade is inescapable.

The second transversal debate arising from the Kyoto Protocol concerns *the optimal effort and the optimal timing of climate policies*. The contributions in this book do not have much to say on the *level* of effort:

they often derive it from exogenously specified constraints (Lafforgue, Magné, and Moreaux in chapter 14 as well as Ambrosi in chapter 15 take exogenously specified bounds). However, the second issue, *timing*, does creep in many chapters.

In a sense, Lafforgue, Magné, and Moreaux are mainly concerned with optimal timing. They address the question within a model that takes two simplified assumptions: first that the objective of climate policies is summarised in terms of a ceiling of concentration, second that the only means of action is the use of sequestration policy, the timing of which is under scrutiny. In this framework, fossil fuel consumption should be curbed well before the sequestration policy is undertaken.

Ambrosi's contribution puts emphasis on the timing problem under stylized assumptions on the abatement cost: the objective does not only refer to the temperature increase generated by a given profile of emissions but also to the *rate* at which the average temperature changes. The relevance of the rate is a priori obvious: rapid change, for example, would impact the ability of species to migrate. Ambrosi shows effectively that the rate of change has a great influence on the timing of an optimal abatement policy.

The timing issue also appears directly in two other papers. By looking at a two period version of a pollution rights market, Redhanz and Tol (chapter 13) explore an issue of prominent importance for the Kyoto Protocol on which too little seems to have been done: How will the international market for quotas evolve dynamically? Although they consider only a limited set of possibilities of transfer between periods, they identify circumstances under which alternative dynamic allocation rules create incentives to accelerate or decelerate emission reductions.

De Cara, Debove, and Jayet (chapter 17) focus attention on the question of aggregation of greenhouse gases for evaluating their relative impact on climate change. The IPCC has promoted a Global Warming Potential index that answers the aggregation problem. The issue may seem foreign to the timing problem, but as the authors show, following earlier inquiries, this is not the case. The right index depends on the rhythm of emissions abatement, which itself depends on the social objective and the discount rate. These are issues with direct connection to the timing question.

But there is a more indirect and subtler aspect to timing. The price versus quantity issue that has received a lot of attention in the literature does not look, a priori, like a timing issue: the question is whether

an environmental policy should aim at controlling the user price of the polluting good or its quantity. Although the two competing tools are equivalent in a certainty world, they are not when costs and benefits are uncertain *ex ante*. Take a static context. Fixing a quantity may *ex post* turn out very expensive, if the realized cost is much higher than the expected cost; similarly, fixing a price without having exact knowledge of the realization of costs and/or benefits can lead to quantity choices that are *ex post* very inappropriate. In a static and uncertain context, a quantity policy and a price policy have different merits. In a dynamical context, the comparison bears on timing. The counterpart of too costly implementation of a quantity objective is too early action (since an excessive move can be corrected tomorrow), whereas the counterpart of a too lenient control of the objective through price corresponds to delayed action.

Whatever the difference in interpretation, the dynamic analysis reproduces the static argument and puts emphasis on the same qualitative factors (slope of the marginal cost curve versus slope of the marginal benefit curve) for which appropriate empirical data are available. Existing studies based on such data suggest that controlling price is better than controlling quantities, as is the aim of the Kyoto Protocol. Although this argument is not unanimously accepted, one may see it as conventional wisdom. It is reiterated with eloquence in Pizer's contribution, and not surprisingly, since Pizer and his co-authors have made this argument academically respectable. While as noted by Guesnerie, Bradford's GPGP is also less subject to the uncertainty bias against quantity, the reader will nevertheless find in the present book a few arguments that challenge the conventional wisdom.

One such argument is made by Sue Wing, Ellerman and Song (chapter 12). They consider controlling under uncertainty the carbon intensity of emissions rather than volume as is the case with the Kyoto Protocol. Controlling the intensity instead of the volume may change the price versus quantity debate, because a lot of the uncertainty about the costs of a quantity policy depends on the rate of growth of GDP, which is *a priori* difficult to forecast. The cost of an intensity policy would then be less uncertain, and this could open the door to a re-evaluation of the asserted superiority of price policy as compared with an intensity policy. Indeed the authors identify plausible conditions under which an intensity-based limit is to be preferred to an absolute one: positive correlation between emissions and GDP is necessary (but not sufficient). However, they draw cautious conclusions, since in some

cases empirical evidence suggests that intensity-based limits may increase the variance of outcomes.

Another and more radical criticism of the conventional wisdom is put forth by Guesnerie (chapter 3). He stresses that the so-called price policy acts through tax but does not directly allow for controlling the price of the polluting goods, namely fossil fuels. Whereas the price change of fossil fuels due to taxation may offset more or less the initial effect, the tax incidence problem remains difficult to ascertain. The simple solution taken by Lafforgue, Magné, and Moreaux (chapter 14) in their intertemporal competitive pricing à la Hotelling gives at least some idea of the extent of the difficulty. Taking into account the uncertainty of prices within a price policy might lead to a drastic reassessment of the conventional wisdom.

In summary, we hope that the variety of insights in this book will motivate future policy debates, particularly with regard to the conditions necessary for global cooperation and appropriate timing of climate policies.

Notes

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1. The other keynote speakers were Roger Guesnerie (chapter 3), Parkash Chander and Henry Tulkens (chapter 8), and William Pizer (chapter 10).
2. "All is for the best in the best of all worlds."
3. The same remark applies to the simple setting taken by Guesnerie in order to model Bradford's GPGP and other post-Kyoto competitors.
4. See, for instance, Germain et al. (2003).

Reference

Germain, M., Ph. Toint, H. Tulkens, and A. de Zeeuw. 2003. Transfers to sustain dynamic core-theoretic cooperation in international stock pollutant control. *Journal of Economic Dynamics and Control* 28: 79–99.

