International coordination on climate policies: a (brief) introduction

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May 12, 2013

Abstract[1]

Given the current trend in global emissions, the latest round of climate change negotiations at the Durban meeting of December 2011 (for the adoption of a comprehensive global treaty on climate change mitigation as soon as possible—and no later than 2015—and to come into force in 2020) has hardly shown the results one would have hoped for. Even for the most optimistic, it remains unclear whether we can expect a successful negotiating outcome by 2015. There are inherent difficulties associated with climate change negotiations, ranging from which countries should bear most responsibility for a given emission reduction target to the assessment of a globally efficient time path for pricing harmful greenhouse gas emissions (GHGs): and these difficulties become even more complex and challenging under the pervasive uncertainty of climate science and the uncertainty about the feedback loop between climate damages and economic growth. During the past decades, the environmental economics literature has provided important insights regarding the design of environmental fiscal policies and treaties but there is a host of issues that remain relatively unexplored. For instance, little do we know about the cooperative solution of carbon and trade policies when climate change affects the productive possibilities of countries. In this context, it is also not obvious whether observed policies could be improved upon in such a way that all countries gain in welfare. It remains also unclear what the carbon extraction path should be in the absence of a comprehensive treaty (such as, for example, if environmental policy is unilaterally chosen subject to an agreed 'ceiling' in global temperature). Though carbon pricing instruments like carbon taxes, cap-and-trade and hybrids have been well studied, not much is known about their properties in the presence of 'offset' schemes such as the Clean Development Mechanism. More work is also required to understand the strategic implications of the uncertainty surrounding climate change and how this affects, for example, the choice of climate change strategy ('precautionary' or 'wait and see'), how uncertainty impacts on the propensity of countries to sign a climate treaty, and the extent to which the possibility of a climate catastrophe fosters or hinders cooperation. Understanding political economy issues is also vital in tackling climate change because efficient climate policies stand little chance of being successfully negotiated and implemented if they do not receive the support of the

[1] The papers that appear in the special issue were all contributed papers to the "Environment and Sustainability Forum" that took place at the University of Exeter in April 2011. All papers have been subjected to the standard *Journal of Environmental Economics and Management* refereeing process. We thank the participants of the conference and the Editor of JEEM, Dan Phaneuf, for his encouragement and advice. We also thank the University of Exeter Business School for its generous support and, certainly not least, the referees who provided invaluable help in the evaluation process of these papers.

electorate. The papers in the special issue of the *Journal of Environmental Economics and Management* are precisely devoted to this broad research agenda.

1. Introduction

Climate change is a global externality: individual emitters of greenhouse gases (GHGs) typically ignore the aggregate damage they inflict on others, thereby emitting more than is desirable from a global perspective. Climate change thus suffers from a collective action problem: a country acting unilaterally will not find it in its best interest to price emissions sufficiently high—and consistent with the common good—since its perceived marginal damage from emitting is small relative to the global marginal damage. From a global perspective, therefore, uncoordinated environmental policies will be set at inefficiently low levels.

Climate change is a particularly complex externality for a number of reasons. First, there are large asymmetries regarding the historical contribution to the current stock of emissions, the current contribution to the stock (80% of current emissions are produced by the high income countries) but also the source of future contributions with the growth in emissions most likely being sourced from non-OECD countries. Second, the impact of climate change are asymmetrically distributed, with a large burden falling on developing countries with low adaptation capabilities. Third, most efficient climate policies will mainly benefit high income groups but impose a proportionally high burden on low income groups if not associated with appropriate compensation measures. Fourth, the inertia of greenhouse gases in the atmosphere means that abatement costs—and the benefits from reduced damages—are spread over a long time horizon, requiring a long-term view to address the climate change problem in a meaningful way, but political decisions are typically taken over a shorter horizon.[2] Fifth, the pervasive uncertainty in climate science and the difficulties of understanding the complexity of climate change impacts makes it difficult to gain political support for taking serious climate change actions. Finally, the very fact that more than 200 countries are involved in this externality problem does not lend support to the hope that the public 'bad' problem can be solved through social interaction, norms, and reciprocity as observed in small communities (Ostrom and Waler, 2003).

All this raises a host of issues for the analysis of environmental policy and, in particular, how to foster cooperation between countries in addressing this global externality. Though the extant literature on international agreements has, to date, provided important insights, much remains to be learnt.[3] For instance, there has been little formal analysis of how a cooperative solution of carbon and trade policies should be designed when climate change affects the productive possibilities of countries. In this context, it is also unclear how observed policies could be improved upon such that all countries gain—a basic prerequisite to receive support

[2] The four issues are also related to the intra- and inter-generational equity concerns. See, for example, Stern (2007), Dasgupta (2007), and Weitzman (2009).

[3] For surveys of international climate agreements see Barrett (2003), and Finus (2003, 2008).

for a cooperative policy. It remains also unclear what the carbon extraction path should be if unilateral environmental policy is subject to an agreed 'ceiling' in global temperature. Though carbon pricing instruments, carbon taxes, cap-and-trade and hybrids are well studied, very little is known about their properties in the presence of 'offset' schemes—such as the Clean Development Mechanism—and under imperfectly competitive markets. Political economy issues are also vital in tackling climate change. Even deeper challenges arise—with profound implications for policy design and environmental agreements—from the pervasive uncertainty in the science of climate change and the prospect of catastrophes.

The papers in this Special Issue address a wide range of policy-relevant issues that are of direct importance in addressing the challenges to developing an effective global agreement on climate change policy. Given the timetable set by the Durban meeting in December 2011, the challenges in progressing climate negotiations are both pressing and significant. This creates an important agenda for environmental economists to provide insights into the factors that will likely drive forthcoming climate negotiations to a meaningful and effective outcome. The papers in the Special Issue provide an excellent example of insights of what the economics profession can offer on this issue.

This Introduction will attempt to provide a brief, and rather selective, overview of some of the analytical issues that have arisen in the literature. Though tempting, we will not provide a detailed 'reader's guide' to the individual papers in this Special Issue. The difficulty with pursuing such a task is that each paper discusses so many facets which makes it difficult to do justice to all aspects in a short space. Instead, we will place the papers contributed to this Special Issue in a broader context.[4] It is clear that all papers presented in this Special Issue deal with a topic that is not only policy relevant but also extraordinarily complex and which poses specific challenges. We hope the challenges highlighted in this Special Issue will provide a springboard for further research on the subject.

2. Some items on the agenda

Given the current trend in global emissions, the latest round of climate change negotiations at the Durban meeting in December 2011 (for the adoption of a comprehensive global treaty on climate change mitigation as soon as possible—and no later than 2015—and to come into force in 2020) has hardly shown the urgency one would have hoped for and it remains unclear whether there will be a successful outcome by 2015. We highlight several issues on the current agenda and comment on how the papers in this Special Issue relate to them.

International Cooperation and Trade Policy The most difficult challenge is the design of an architecture that encourages participation among the world's largest GHGs emitters and

[4] More comprehensive overviews can be found in Finus (2001), Copland and Taylor (2004), Aldy et al. (2010), Chen and Woodland (2013), and Jones et al. (2013).

implements emission ceilings significantly different from the business-as-usual path.[5] If past experience from previous climate change negotiations is any guide, there is no room for anyone to be overly optimistic about a successful negotiating outcome by 2015.

Full international cooperation is needed to limit concerns about international competitiveness and emissions leakage. A fully coordinated approach would require an appropriate balance of efficiency and equity considerations. Kotsogiannis and Woodland (this issue) show—within an international trade framework in which the global impact of emissions is through *productive* factors—that such an approach would involve uniform carbon pricing across all countries (with international transfers[6] addressing cross-country equity issues). Such a policy is also production efficient. In the absence of international transfers—distributional issues become a major concern in climate change negotiations[7]—uniform carbon pricing is no longer feasible: carbon taxes now have to reflect equity considerations too.[8] In this case, constrained Pareto-optimality requires that low-income countries tax emissions at a lower rate than high-income countries.

The Pareto efficiency characterisation is important but it also relevant to know if observed policies could be improved upon in such a way that every country gains in welfare terms. Kotsogiannis and Woodland (this issue) show that one can envisage environmental policy reforms that can deliver—starting from a Pareto-inefficient equilibrium—welfare improvements in all countries. Such a policy reform would be one, for instance, that closes the 'gap' between existing carbon taxes and the optimal ones and redistribute the efficiency gains through cross-country transfers. There are, of course, important practical issues around the implementation of such reforms and progress, for mainly political reasons, is likely to be painfully hard.

The Political Game of Cooperation A fully coordinated approach is not the likely outcome in the short to medium term. There are, though, signs of unilateral action and binding commitments—and partial coordination by a subset of countries—on mitigating climate change. The European Trading System, for example, covers 31 countries. Moreover, the European Union has proposed a 20 percent emission reduction by 2020 which they will increase to 30 percent if matched by other countries (though what 'matching' means exactly remains unspecified). More recently, Mexico has unilaterally adopted ambitious legally binding targets to reducing greenhouse gas emissions by 30% by 2020 and by 50% by 2050, as well as setting a target on GHGs, stipulating that 35% of Mexico's energy will have to come from renewable sources by 2024. Similar legislation has been also enacted in the UK in 2008 with the pledge to reduce GHGs by at least 80% by 2050. Other countries may follow

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5 The Kyoto Protocol failed to do this as non-Annex 1 countries, including China, Brazil, South Africa, Mexico and Indonesia, did not accept any emission ceilings, while the United States withdrew from the agreement.

6 Such transfers can be either explicit or implicit, through the appropriate choice of trade taxes. See also Keen and Kotsogiannis (2013).

7 Distributional effects are in particular a major concern in many development countries.

8 See Keen and Kotsogiannis (2013) for a formal description of Pareto-efficient policies when the impact of emissions is through utility. See also Sandmo (2005).

suit. But these promises, even if implemented, will likely fall short of what would be required to limit global warming to the required 2°Celcius (the target proposed by the FCCC conference in Rio de Janeiro in 1992 and which has been reiterated in all follow-up meetings since then).

But why do some countries choose to coordinate and others not? Cost-effective pricing of GHGs can be achieved through the linking of national with the international tradeable permit system.[9] Yet, despite this, and notwithstanding the initial commitment and intentions of many countries, little progress has been made on this front.[10] One possibility for the lack of progress could be, arguably, complex political economy considerations[11] relating, in particular, to the role of interest groups. It is well-established that the presence of interest groups matters for the design and implementation of economic policy—an issue that has not, rather surprisingly, received the attention it deserves in the context of international agreements.[12] The role of pressure groups in the context of international environmental cooperation poses some specific challenges. There are several aspects to consider that stretch beyond solely domestic policy considerations. It is important to recognise (and also to identify the mechanisms how outcomes are determined) that political influence is exerted at several stages (but perhaps to a different degree at each) of the decision to cooperate. Political pressure might, for instance, shape the incentives to be part of an international agreement and, in turn, the emission levels countries target. Even if an agreement is signed, ratification and implementation of agreements also become issues for which the role of interest groups can be important. It is also clear that interest groups, like NGOs, may lobby across borders, and some may have not only national but also international interests.[13]

The political economy aspects of climate change policy are taken up by Habla and Winkler (this issue).[14] Focussing on the first two aspects of the political process (that is, whether countries join an international permit market and, if they join, which emission level they will choose), Habla and Winkler show that participation in an international permit scheme is not independent of domestic politics. To the contrary, there is an inherent conflict between emission-intensive sectors and consumers which could make participation in an international permit scheme difficult to achieve.[15] Interestingly, for even the most influential interest groups, there are additional factors that may frustrate them in the context of international permit trading. The reason for this (and this is an issue that arises in Habla and Winkler) is that the benefits derived for the interest groups depend on the balance of two effects; while

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9 Such a market would provide the mechanisms and flexibility necessary to achieve an emission target at the lowest cost providing also the incentive for other countries to join.

10 See de Serres et al. (2011).

11 A typology of these considerations is offered by Ruhl (2012).

12 Predominantly, the literature on environmental agreements has focused on cooperation between welfare-maximising governments. The lack of modelling the political process within countries is emphasized in Carraro and Siniscalco (1992). Recent contributions that introduce politics into environmental agreements are Altamirano-Cabrera (2007), and Dietz et al. (2012).

13 See Hillman and Ursprung (1994) for an application to trade policy.

14 A review of the political economy of environmental policy focussing on domestic issues is covered by Oates and Portnoy (2003).

15 See also EBRD (2011).

they (pressure groups) influence the government to set emission targets that benefit them, the strategic inter-play between governments changes the outcome in a way that can be harmful for them. If the latter effect dominates the former, interest groups will end up with their less preferred outcome.[16]

It would be also interesting—a point also emphasized in Habla and Winkler—to understand the political economy of permit markets when countries form a cooperative international climate agreement. It is intuitive—and recent results by Altamirano-Cabrera and Finus (2006) confirm this—that the allocation scheme in place will play a critical role in whether lobbying groups will lend support to the governments to join such a treaty. The low carbon price in the EU-ETS is a clear sign how industry lobbies can affect the success of climate policy. It also illustrates that interest groups do not only compete in a domestic setting, but that there is scope for pressure groups across borders to jointly lobby for their interests. Undoubtedly, there is scope for further research on the role of pressure groups in the context of global climate policy. This is particularly important for understanding the reasons why, often, recommendations by economists do not fall on fertile ground.

Another possibility, and closer to the current policy debate, is the roles of border tax adjustments (BTAs) as a credible device for ensuring cooperation. A BTA takes the form of imposing a tariff on imports which equals the domestic carbon tax but which is not charged abroad. It can also include a refund on exports equal to the carbon tax not charged on the production of the same good abroad.[17] BTAs have been shown to mitigate carbon leakage since the competitive disadvantage of carbon-pricing countries is offset by the BTA. Moreover, a BTA is considered as one of the few credible devices by which countries implementing carbon pricing can encourage participation by others: participants would benefit by imposing a carbon price themselves since by doing so they would capture revenues otherwise accruing to others. Against this, however, BTAs risk hiding protectionism—and may be inconsistent with the World Trade Organization rules—but also may risk trade retaliation. BTAs, perhaps more importantly, also raise the very practical issue of implementability, including the need to assess the carbon content of the imported goods. Ultimately, the importance of BTAs—both in terms of the magnitude they should take in practice as well as the environmental consequences they would give rise to—is an empirical question. Though some progress on this issue has been made, clearly, more is needed.[18] In all this, political economy issues cannot be ignored. For instance, one would expect that a BTA policy is not only driven by concerns about the competitive disadvantage of carbon pricing but also the pressures originating from interest groups.

Strategic Incentives and Partial Cooperation. Under the Kyoto Protocol, countries can be divided into Annex B and non-Annex B countries, the distinction between these two groups being that the former accepted emission ceilings while the latter (though signatories to the

16 This observation, albeit in a different context, has been highlighted in, for example, Aidt (2005), and Conconi (2003).

17 See Keen and Kotsogiannis (2013) for a formal characterization of BTAs.

18 Recent overviews which address the BTA issue include Frankel (2009), and Mattoo et al. (2009).

Protocol) did not. In this context, the role of 'offsets' has become an important feature of the global climate architecture, the most well-noted being the Clean Development Mechanism (CDM). The purpose of offsets is straightforward: Annex B countries can partly meet their emission reduction commitments by undertaking emission-reducing projects in non-Annex B countries. These offsets thus offer two important advantages: first, they encourage sustainable development in non-Annex B (typically developing) countries; second, they allow Annex B countries to meet their emission reduction commitments more cheaply. However, the question is how do offsets interact with the incentives to set climate change policy? This is an issue taken up by Strand (this issue).

Strand divides the world into three blocs: (i) fossil fuel-importing countries which coordinate their climate change policy; (ii) fossil fuel-importing countries that take no action in terms of setting policy but offer 'offset' to the policy group; this group does not coordinate and is called the fringe, and (iii) fossil fuel-exporters. Although the latter group has no environmental policy in place, as environmental concerns play no role, it can tax exports in order to extract monopoly rents from the supply of fossil fuels. In such a framework the presence of offsets influences the carbon taxes set by the policy group (and the choice between carbon taxes and cap-and-trade).[19]

With offsets now likely to be an established feature of the global climate architecture, a number of issues remain to be addressed.[20] For example, if emission targets are set endogenously, how does the presence of offsets affect emission targets?[21] If cheaper abatement options translate into more ambitious abatement targets by the environmental policy group, the incentive of the fringe countries to join the policy group may even be negatively affected. 'Additionality' may be an option to countervail this effect by shifting the gains from the offset mechanism from the fringe to the policy group. This may also address the problem that many projects financed under CDM would have been implemented anyway (see, for instance, Fischer (2005) and Flues et al. (2012)). In addition, the strategic manipulation of the efficiency gains from undertaking the projects[22] raises a set of interesting (and relatively unexplored) issues.[23] Dynamic issues—though more analytically complex to deal with—also need to be addressed in the context of offset schemes (see Karp et al. 2013). For instance, the issues discussed earlier regarding the impact of offsets on environmental policy group participation (and, therefore, on the effectiveness of climate agreements) become even more important when seen through time. It is clear that if the offset mechanism

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19 And so the equivalence between carbon taxation and cap-and-trade. It is well know that the equivalence fails if there is imperfect competition in the carbon market or there is uncertainty about the abatement cost functions. In the latter case, optimal policy for climate change mitigation favours the use of tax over permits (Weitzman 1974). Also volatility of carbon prices maybe greater under cap-and-trade since aggregate emissions do not respond flexibly to aggregate shocks, McKibbin (2004).

20 Not to mention the issue of dealing with countries either non-participating or withdrawing from environmental agreements (as in footnote 5).

21 See Bréchet et al. (2012), and Lessman et al. (2012).

22 The reason is the dependence of the (implicit) subsidies on a country's planned (or intended) choice, because incentives contingent on the agent's own behaviour encourage strategic reactions.

23 See, for instance, Wirl et al. (1998), and Strand and Rosendahl (2012).

is very attractive for non-Annex B countries, it might be difficult to convince those countries to join a future climate treaty and accept emission ceilings.

The extraction decision of competitive firms—and in the absence of externalities—for non-renewable resources is the one that follows Hotelling's rule that the price of the resource increases at the rate of interest. This rule has been extensively used in various settings to determine the optimal path of extraction of carbon-emitting exhaustible resources. But what is the optimal path of extraction if there is unilateral emissions policy from a subset of countries? Eichner and Pethig (this issue) consider a standard non-renewable resource extraction problem with partial ownership of the resource.[24] The question they address is what is the optimal path of extraction if a subset of countries (forming a uniform policy bloc) aims to unilaterally reduce emissions in order to meet a global target (for example, a policy ceiling in the sense of global temperature not exceeding the rise in temperatures beyond 2^{o} Celsius) being aware of potential leakage effects and facing the constraint to achieve this at minimal abatement costs?[25] They show that an optimal unilateral policy depends on the terms-of-trade incentives (and so whether the unilaterally acting country is an exporter or importer of the resource), the distribution of resource ownership and the size of the resource.

International Cooperation, Uncertainty and the Possibility of Catastrophes As noted earlier, the challenges to attaining agreement between countries are broad and complex. Successful agreements need effective compliance procedures with harsh but also credible sanctions that deter countries from not honouring their treaty obligations. This necessitates agreements on the principles of monitoring, reporting and verifying: issues that have proved particularly contentious in international negotiations (raising sensitive issues of national sovereignty too). Future climate treaties will only be successful if the largest current and future polluters participate. In light of strong free-rider incentives, this requires 'clever' designs of climate treaties.[26] Uncertainty and learning are likely to be important determinants in climate treaty formation (Finus and Pintassilgo, 2012, 2013, Kolstad, 2007, Kolstad and Ulph, 2008, 2011). The role of thresholds—analyzed in the experimental literature on public good games (see, for example, Milinski et al., 2008, Dannenberg et al., 2011)—is also likely to play an important role. Scott Barrett (this issue) combines these two strands of literature and asks the question whether, and under which conditions, the possibility of catastrophic events change the incentive structure of countries to join a climate treaty. Barrett shows that the threat of a catastrophe changes the nature of the game: a game of cooperation now becomes a game of coordination, with an agreement functioning as a coordination device in which all countries settle for full cooperation. He demonstrates that the nature of the equilibrium does not change if the impact of the catastrophe is uncertain, but it will if there is

[24] Optimal extraction in the presence of greenhouse gas emissions has been considered for instance by Ulph and Ulph (1994), and Chakraborty et al. (2006). The optimal extraction path depends on the technologies that are available to reduce atmospheric CO_2. See also Coulomb and Henriet (2010).

[25] The possibility of the green paradox (see Sinn, 2008)—arising because fossil fuel producers shift extraction to earlier periods to avoid future (more stringent) climate policies—is being ruled out by assumption.

[26] Game-theoretic models on compliance and participation are extensively discussed in Finus (2001, 2003). How various designs of treaties influence and interact with participation is also discussed in Finus (2008).

uncertainty about the threshold of the tipping point (catastrophe). This will also be the case if there are multiple thresholds: what uncertainty does in effect, in these cases, is to smooth out the discontinuous damage function with catastrophes. Thus, the mere fear of 'approaching' catastrophes will not automatically solve the problem of lack of cooperation if there is uncertainty about the threshold, which is most likely the case.

Whereas Weitzman (2009) has drawn our attention to the potential implications of low probability and high impact events for optimal climate policy (see also Millner 2013), Barrett (this issue) emphasizes the strategic incentives for international cooperation. Interestingly, the introduction of climate change dynamics generates a subtle change in how one addresses the question about international cooperation: from the perspective of individual countries, are international agreements desirable to limit the gradual path of global emissions or should they participate in climate agreements to (only) avoid catastrophic events? This also, naturally, leads to the question whether adaptation and climate engineering—as additional options to address the climate problem—will also change the incentive structure for coordination and cooperation among countries. After all, climate engineering is seen as a back-up option, particularly suited before an impending catastrophic event, due to its immediate and cheap availability. But it is also a controversial one, given the possibility of high collateral damages. Dynamic issues will also be important if there are multiple unknown thresholds (a more plausible case than a single threshold). The unequal distribution of the benefits and costs of catastrophic events across countries may also impact on the incentives for coordination. And, of course—within a dynamic context—uncertainty about thresholds will also complicate matters. Climate science suggests that the time path of temperature increases may slow prior to catastrophic events which may provide some guidance of how to identify the threshold of extreme events, but this conclusion has not yet been confirmed and, hence, is highly uncertain.[27]

3. Concluding Remarks

There is no doubt that there is a vast and diverse agenda of issues that are still relatively unexplored. Theoretical analyses such as the ones displayed in this Special Issue of the *Journal of Environmental Economics and Management* can be especially important in pushing forward this important and policy-relevant research agenda. Of course, there are many more issues still unresolved, but the papers here provide an excellent sample of the range of theoretical research in a field of deep intellectual challenges.

[27] 'Critical slowing down' has been recently highlighted by Scheffer et al. (2012).

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