INTERNATIONAL ENVIRONMENTAL NEGOTIATIONS

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Contents

Summary

This paper provides an analysis of international environmental negotiations and agreements by focusing on the link between policy options on the one hand, and the structure of the agreements on the other. In particular, the paper analyzes whether there exist the conditions for agreements on global environmental problems to be signed by all or almost all world countries; and whether some countries can play a strategic role, with respect to the goal of achieving the largest possible agreement, by proposing policies, measures, and institutions that help expand the number of countries which commit to control their emissions.

1. Introduction

International agreements among sovereign nations are increasingly important in a global economy. The range of topics is wide. Transnational issues, such as trade and financial flows liberalization, migrations, technological co-operation, development-aid and environmental protection are the most important problems discussed in G-8 and EU meetings as well as in big international conferences aimed at approving world-wide conventions on specific matters (Cf. Nordhaus, 1999). The common feature of the issues under discussion is a high degree of interdependence among countries: in general, the welfare of each country depends on its own action as well as on the action of any other country so that, in some cases, unilateral policies can be jeopardized and possibly made useless by the other countries' reaction. Hence, the need for policy co-ordination.

Among the transnational policy issues, environmental protection is a limiting case. In areas such as global warming, ozone layer depletion and biodiversity, spillovers, as well as the absence of clear property rights, create strong incentives to free ride which undermine co-operation. Hence, the difficulty of reaching agreements which are both effective and widely accepted.

The above problems are not new to economists, and have been analyzed in the area of externalities and public goods. What is new is the context where these problems take place. Currently, the global environment is managed as global common-property goods, and there is no institution which possesses powers to regulate their use by means of supra-national legislation, economic instruments, or by imposing a system of global property rights. Hence, the necessity to design negotiation mechanisms leading to self-enforcing agreements, i.e. agreements to reduce environmental damage which are voluntarily signed by a large group of countries (large enough to keep the environmental damage under control).

In the recent history of international agreements to protect the global environment, one can observe different attempts to achieve co-operation among countries. One first attempt has been to design world-wide agreements to cut emissions by bargaining solely on emissions. The result of these negotiations has been usually frustrating. The conventions, whenever signed by a great number of countries, are rather empty in terms of quantitative targets and/or deadlines. Otherwise, they are signed by a few countries, if any.

The dissatisfaction with such an outcome, and in particular with agreements signed by a small group of cooperating countries, led towards attempts at expanding the agreements by bribing reluctant countries by means of transfers. Alternatively, but with the same goal, the negotiating experience is trying to link environmental protection to other international agreements: on technological co-operation (as in the case of the Climate Change Convention) and trade (as in the environmental clause in GATT/WTO).

There is therefore a problem of targets vs. instruments. Should countries agree on emission paths (as, for example, in the Kyoto Protocol) or on policy instruments (for example an international carbon tax as proposed in Nordhaus, 1999)? But there is also a problem of strategy. Should negotiations focus only on environmental policies or should they be linked to other policy issues? How can transfers help in expanding an environmental coalition? This paper aims at discussing the possible answers to these questions, but it also raises a more fundamental question. Should countries persist in their attempt to achieve a world-wide agreement on emissions reduction? And if not, what could the target be? A partial coalition where only a sub-group of countries signs the environmental convention? Or a set of regional agreements specifically designed for the countries in each world region? In addition, are there rules or appropriate features of the environmental treaty which can make it more acceptable (i.e. it will be signed by a larger number of countries)?

In order to understand the roads towards an effective, efficient and equitable environmental agreement, let us re-call some of the basic features of international

environmental negotiations. These can be summarized as follows:

- All world countries are involved and required to take a decision on whether or not to sign an international environmental treaty, with important implications on their economic policies and consequently on their welfare.
- No supra-national authority can enforce such a treaty which must therefore be signed on a voluntary basis.
- A no-commitment to co-operation outcome is likely to be credible. Only positive economic net benefits, which may include environmental benefits, can lead countries to adhere to an international agreement on environmental protection.
- The global environment is a public good. As a consequence, all countries are going to benefit from the emission reductions undertaken by a subgroup of one or more countries. There is therefore a strong incentive to free-ride.
- Parties involved in the negotiations seem to be conscious that an agreement signed by all world countries is not likely and that the effort of emission abatement has to be concentrated on a sub-group of (more developed) countries.
- Developed countries however know that an international treaty on emission control is effective only if a sufficient number of countries decide to sign it (in particular the main developing countries). Therefore, they need to design appropriate strategies to induce developing countries to sign the agreement.

The goal of this chapter is to analyze the incentives that countries have to sign an international agreement on emission control. Starting from the basic features of international environmental problems outlined above, we discuss under what conditions for the countries involved, (the damaging effects of free-riding, for instance, or the structure of costs and benefits), a coalition -- i.e. a group of signatories of the international agreement, can emerge. We will consider two main cases: (i) environmental negotiations focus on a single agreement which countries are free to sign or not; (ii) environmental negotiations are designed in such a way that countries can sign either a global agreement or, if more profitable, a set of regional agreements (in a way that mimics the formation of trade blocs).

This chapter argues that, despite the public good nature of international environmental problems, a coalition is going to form endogenously, i.e. a group of countries, but not all countries, will have the incentive to sign an international agreement to protect the environment. However, when countries are free to choose, they prefer to agree on the formation of several regional agreements, rather than on the design of a single global agreement. This may be a relevant input for current international environmental negotiations.

As far as instruments are concerned, we will consider the role of transfers and of "issue linkage" as ways to broaden an environmental coalition, i.e. as a way to increase the number of signatories of an international environmental treaty. We will show that both these instruments have important drawbacks and may not lead to the formation of a large coalition.

Two important variables are going to affect the conclusions that will be presented in the next sections:

- the size of leakage, i.e. the change of emissions in non-signatory countries induced by the abatement decisions in signatory countries, e.g. through changes of world oil prices or industry re-locations (Carraro and Siniscalco, 1993);

- the negotiation rules adopted by countries before starting the actual negotiations. Indeed it is crucial for the outcome of international negotiations to define according to which rules countries can join and/or leave the coalition and under which rules the treaty is going to enter into force (Carraro and Moriconi, 1998; Carraro, Moriconi and Oreffice, 1999). For example, in Kyoto it was decided that the Protocol would enter into force only if at least 55 countries signed it and the signatories represented at least 55% of total emissions.

This chapter explores how all the above elements affect international environmental negotiations and the possible emergence of stable environmental agreements. The next section reviews some results of coalition formation theory that will be useful in understanding the analysis of the following sections. Section 3 analyses under what conditions different types of agreements may emerge and which policy options can help induce countries to sign international environmental agreements. Finally, section 4 proposes some conclusions and directions for future research.

2. Coalition Formation

If the goal is to understand which international regime is likely to emerge to control international or global emission levels, game theory is certainly the best tool to deal with it. Indeed, game theory has extensively analyzed the possibility of coalition formation in the presence of free-riding (i.e. when parties have to agree on the provision of a public good). Early contributions (Cf. Hardin and Baden 1977) characterized the environmental game among countries as a prisoner's dilemma, inevitably leading to the so-called "tragedy" of the common property goods. But in the real world, at the same time, a large number of international environmental agreements on the commons were signed, often involving sub groups of negotiating countries and sometimes involving transfers and other links to other policies (trade, technological cooperation, etc.). It was therefore necessary to develop new models which helped us understand the logic of coalition formation in the presence of spillovers, and the possibility of increasing welfare by means of appropriate mechanisms and strategies. These new models were developed in the last decade within a non-cooperative game-theoretic framework, and provide interesting indications on the likely outcomes of environmental negotiations.

Consider first the case in which countries negotiate on a single worldwide agreement. Most papers in the game-theoretic literature on coalition formation applied to environmental agreements (Hoel, 1991, 1992; Carraro and Siniscalco, 1992, 1993; Barrett, 1994, 1997b; Heal, 1994) propose the following conclusions:

- The presence of asymmetries across countries and the incentive to free-ride make the existence of global self-enforcing agreements, i.e. agreements which are profitable to all countries, and stable, quite unlikely (Carraro and Siniscalco, 1993). (A coalition is stable if no cooperating country has any incentive to exit the coalition and no free-riding country has any incentive to enter the coalition.)
- When self-enforcing international environmental agreements exist, they are signed by a limited number of countries (Hoel, 1991, 1994; Carraro-Siniscalco, 1992; Barrett, 1994).
- When the number of signatories is large, the difference between the cooperative behavior adopted by the coalition and the non co-operative one is very small (Barrett, 1997b).

These results are robust with respect to different specifications of countries' welfare function, and with respect to the burden-sharing rule used in the asymmetric case (Barrett, 1997a, Botteon-Carraro, 1997a). [n the asymmetric case, the rule which is chosen to divide the gains from cooperation among the countries in the coalition (usually called burden-sharing rule) plays a crucial role because it affects the likelihood that each country decides to sign the agreement. The burden-sharing rule is usually taken from cooperative game theory and Nash's and Shapley's one is the most used. By contrast, in the symmetric case different rules lead to the same outcome -- equal shares.] The results suggest that the attempt to negotiate on effective emission reductions is unlikely to lead to a coalition formed by all or by almost all countries, unless more complex policy strategies, in which environmental policy interacts with other policy measures, are adopted.(Surveys of the above literature are proposed in Barrett (1997b), Carraro (1999a), Tulkens (1998).)

For these reasons, in the game-theoretic environmental economics literature, two main sets of instruments have been proposed to expand environmental coalitions, i.e. to increase the number of signatories of an environmental agreement. These instruments are "transfers" and "issue linkage". These will be analyzed in section 3.3. which deals with partial agreements and the ways to broaden them. (In the last two decades, political scientists also focused their analyses on the emergence of cooperation in the presence of free-riding (Axelrod, 1984; Brams and Kilgour, 1988; Hampton, 1987; Oye, 1986; Taylor, 1987; Wagner, 1983). Their conclusions are very close to the ones achieved by economists, i.e. even in the case of public good provision, a coalition forms at the equilibrium, but some countries are allowed to defect.)

Consider now the case in which countries are free to sign the agreement proposed by a group of countries or to propose themselves a different one to the same or to other countries (Carraro, 1998). This may lead to the formation of multiple environmental agreements similar to what happens in the case of trade blocs (Bloch, 1997; Carraro and Moriconi, 1998; Yi, 1997). The multiplicity of coalitions may allow for region-specific agreements in which the characteristics of countries in the region are better reflected by the contents of the agreement. Even in this case, game theory provides a clear analysis of the outcome of international environmental negotiations. (Unfortunately, game theory is far from having achieved a well-defined non-cooperative theory of coalition formation under the above general assumptions and definitions. There are several stability concepts that can be used and which unfortunately provide different equilibrium coalition structures. Among them, let us recall the concept of equilibrium binding agreements proposed by Ray and Vohra (1997) However, despite the large number of equilibrium concepts, the concepts of α-stability and β-stability proposed in Hart and Kurz (1983), the sequential stability concept of Bloch (1997), the open-membership stability proposed by Yi (1997) and the farsighted stability concept used in Chew (1994), Mariotti (1997)), some conclusions seem to be quite robust:

- The equilibrium coalition structure is not formed by a single coalition. In general, many coalitions form at the equilibrium.
- The grand coalition, in which all countries sign the same environmental agreement, is unlikely to be an equilibrium
- Coalitions of different sizes may emerge at the equilibrium (even when countries are symmetric).

The specific results on the size of the coalitions depend on the model structure and in particular on the slope of countries' reaction functions, i.e. on the presence of leakage. If there is no leakage and countries are symmetric, then the Nash equilibrium of the multi-coalition game is characterized by many small coalitions, each one satisfying the properties of internal and external stability (this result is shown in Carraro and Moriconi, 1998).

The remaining questions are therefore policy ones. Is countries' welfare larger when one or when several coalitions form? Also, what about environmental effectiveness? The answers are still uncertain, both because theory provides examples in which a single agreement is preferred, at least from an environmental viewpoint, to many small regional agreements (and vice versa), and also because empirical studies have not yet convincingly addressed this issue. Moreover, the conclusion crucially depends on the choice of the equilibrium concept and on the size of leakage.

The consequence of the results discussed above is that the rules of the negotiation process are a crucial factor in explaining its outcomes. If all countries negotiate a single agreement, the incentives to sign are lower than those which characterize a multiple agreement negotiating process. But at the equilibrium the environmental benefit (quality) may be higher in the case of a single agreement.

Can we say something more precise on the likely coalition(s) that can emerge at the equilibrium? In the next section, we would like to achieve, at least partially, a synthesis, by exploring the outcomes of the interactions between different coalition structures (international regimes) and different policy options.

3. International Environmental Agreements

3.1. No Participation

This case constitutes the benchmark with respect to evaluating the costs and benefits of policies designed to control emissions under alternative coalition structures. It is usually named the "business as usual" scenario, because it identifies the values of the main environmental and economic variables when no coalition forms and no action, unilateral or co-operative, is adopted (the IPCC second assessment report is a good example of this approach). The construction of the business as usual scenario is very important to assess both the profitability and the stability of a coalition (i.e. whether it is self-enforcing). As has been said, a coalition is profitable when welfare after the coalition is formed is larger than in the no participation case. A coalition is self-enforcing if there are no incentives to leave or enter the coalition. The business as usual scenario crucially affects these incentives. If the no participation case is such that emissions are declining and that the target can easily be achieved through small emission reductions, than the incentives to join the coalition (sign the agreement) are much higher, i.e. a coalition with many countries is more likely to form (Barrett, 1997b). Symmetrically, if large emission reductions are necessary, both abatement becomes more costly, and incentives to free-ride increase, thus further increasing costs for co-operating countries (particularly if leakage is high).

A careful definition of the no participation case is therefore very relevant to assess the likelihood of large coalitions and thus the efficiency of an international environmental agreement. But it is also very relevant in terms of equity. When the burden of emission abatement has to be equitably shared, it is important to distribute emissions reductions with reference to the business as usual scenario. Each country has therefore an incentive to pretend that its own business as usual scenario implies larger emissions than what is actually true (Bohm, 1999). In this way, the actual cost for the country would be lower. An optimistic scenario, in which predicted emissions are lower than "true" emissions (as measured ex-post), leads countries to agree on low emission reduction targets, but forces countries to reduce more later and to pay abatement costs larger than expected. A pessimistic scenario makes the agreement more difficult because larger emission reduction has to be agreed upon, but countries find themselves in a better situation and pay lower costs ex post. Hence, if a country succeeds in convincing the other ones that its own business as usual emissions are larger than the "true" ones, than this country achieves a relative benefit in terms of less stringent emission targets and lower abatement costs.

The definition of a business as usual scenario has therefore a strategic dimension and can hardly be defined as an "objective" evaluation of future economic and environmental cycles and trends. It is therefore important to collect the largest amount of information from different sources and to identify the scenario more as an average of much scattered information than as a subjective analysis of likely future events. This may reduce the likelihood of strategic definitions of the business as usual scenario and may partly prevent the consequent impacts on the equilibrium coalition and on the assessment of costs and benefits of environmental policies.

3.2. Unilateral Participation

There is a wide literature that analyses the costs and sometimes the benefits of introducing policies to control polluting emissions in a single country (Bucholz and Konrad, 1994; Endres and Finus, 1998; Hoel, 1991; Hoel and Schneider, 1997; Porter and Van Linde, 1995). Given the arguments proposed in the Introduction, and the results summarized in Section 2, this type of exercise may seem unreasonable. There are, however, two main justifications for undertaking it. The first one is that domestic abatement costs (related to domestic policies and measures) hardly depend on the coalition structure. Indeed, only if leakage is large, and if environmental policies have a large impact on trade and financial flows, then the costs of domestic abatement policies are significantly affected by the size of the coalitions and by the agreed emission targets. Therefore, it may be useful to compute the costs of unilateral participation as a benchmark case, which identifies costs that can only be reduced when a coalition forms and incentive and market-based mechanisms are implemented among signatory countries. Notice the importance of a careful assessment of leakage and of trade and financial repercussions of climate policies (McKibbin et al. 1998). Notice also that the above arguments concern costs but not benefits of environmental policies. Indeed the benefits of unilateral participation are likely to be zero or almost zero for all or almost all countries (a possible exception is the U.S.) given the global nature of the problem (Hoel 1991, Bucholz and Konrad 1994, Endres and Finus 1998).

A second reason for undertaking the assessment of the cost of a unilateral participation is that it could lead to identify a series of low costs (or no cost) options (the so-called "low hanging fruits" or "no regret actions") that could be implemented independently of the formation of an environmental coalition. It could also help identifying policy mixes that help to restructure the fiscal system and public regulatory and incentive schemes in such a way that emission abatement costs are more than compensated by other economic (non environmental) benefits (the so-called double dividends).(See Goulder (1995), Bovenberg (1997), Bosello, Carraro and Galeotti (1999) for surveys of this literature.)

There are also cases in which unilateral actions have been analyzed under a very specific viewpoint. For example, Bucholz and Konrad (1994) analyze the detrimental effect of pre-negotiation actions (more bargaining power can be achieved by unilaterally increasing emissions before negotiating). Endres and Finus (1998) examine the negative effects on negotiations of a higher environmental consciousness in one country, Hoel (1991) analyses the costs of unilateral actions, Hoel and Schneider (1997) the role of social norms, while Porter and Van Linde (1995) focus on the advantage of being a leader by adopting emission reductions before the other countries.

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