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Cahiers de la MSE

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2005.53

Maison des Sciences Économiques, 106-112 boulevard de L'Hôpital, 75647 Paris Cedex 13
http://mse.univ-paris1.fr/Publicat.htm
ISSN : 1624-0340

POLITICAL-SUPPORT LOBBIES RESPONSES TO INTERNATIONAL ENVIRONMENTAL AGREEMENTS

Houda HAFFOUDHI[♦] [*]

Abstract

Studies of the stability of international environmental agreements (IEAs) assumed a benevolent government who maximizes social welfare. The aim of our paper is to develop a theoretical framework in which the Government's decisions are influenced by green and producer lobbies. To this end, we extend the political support approach of Hillman (1982) and model the IEA formation as a two stage non-cooperative game. Our work studies the coalition formation process and determines both coalition abatement level and the size of stable coalition. The basis conclusion that emerges from the analysis of politically motivated coalition formation is that government's decision depends not only on ecological vulnerability and abatement cost in each but also on the political strength of green lobby over industrial lobby and its capacities to give political support to the government.

Keywords : non-cooperative game, interest group, coalition theory, environmental Policy.
JEL Classification : C72, D72, D78, Q28

Résumé

La littérature économique sur la stabilité des accords environnementaux internationaux (AEI) suppose des gouvernements bienveillants qui maximisent la fonction de bien-être social. Le but de notre papier est de développer un cadre théorique dans lequel la décision d'un gouvernement est soumise à l'influence de deux groupes de pression : environnementaliste et industriel. Pour se faire, nous étendons l'approche de soutien politique de Hillman (1982) et modélisons la formation des AEI comme un jeu non-coopératif à deux étapes. Notre modèle permet d'étudier le processus de formation de la coalition et de déterminer à la fois le niveau de dépollution de la coalition et la taille de la coalition stable. La principale conclusions qui émerge de notre analyse est que la décision de participation à la coalition internationale dépend non seulement de sa vulnérabilité écologique et des coûts de la politique de dépollution mais aussi du poids politique du groupe de pression environnementaliste par rapport au groupe de pression industriel et sa capacité à soutenir le gouvernement.

Mots-clés: Jeux non-coopératifs, groupes de pression, théorie de la coalition, politique environnementale.
Classification JEL : C72, D72, D78, Q28

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[*] The author is grateful to all participant to annual meeting of the European Public Choice Society (EPCS), (Aarhus, Avril 2003) for comments on an earlier version presented. Any remaining errors in the paper are our responsibility.

1 Introduction

Some of the most important environmental problems urgently calling for solution are problems related to global pollution. Environmental problems such as ozone depletion, climate change and marine pollution have been the focus of intense negotiations at the international level over the past two decades. Given the high priority environmental problems receive at the policy level; it is not surprising that there is a growing effort to analyze International Environmental Agreements (IEAs) at the theoretical level.

The literature on coalition formation analyzing the IEAs has grown immensely over the recent years. Two basic stands may be distinguished: the first stand estimates the costs and benefits of various abatement targets under different cost allocation rules. Bohm and Larsen (1993), Fankhauser and Kverndokk (1996), Welsch (1992, 1995), and Tahvonen (1994) identify the winners and the losers of hypothetical agreement to reduce "greenhouse gases" whereas Kaitala, Pohjola and Tahvonen (1992), Mäler (1989) and Newbery (1990) identify them in the case of transboundary fluxes. In this literature, the rationale for a group of countries to form an IEA is based on whether the group as a whole is better off than in the statu quo. Nevertheless in this condition, one has to check whether the omnipresent free-rider incentive in an international context can be controlled by appropriate measures.

These incentives represent the focus of the second stand of literature which studies within a theoretical framework the conditions under which a number of countries will accede to an IEA and what is needed to broaden the coalition. Except Chander and Tulkens (1992, 1995), all papers employ stability concepts of non-cooperative game theory. The reason is that IEAs must be self-enforcing because no binding commitments are possible. Basically, the models of Barrett (1994b), Bauer (1992), Carraro and Siniscalco (1992, 1993) and Hoel (1992) use a stability concept borrowed from the oligopoly literature (D'Aspermont, et al., 1983) where a coalition is said to be stable if no country wants to accede to the coalition (external stability) and no country wants to leave the coalition (internal stability). The equilibrium size is determined as an adjustment process of signatories and non-signatories. This is particularly evident in Barrett (1994a, b) where signatories behave as Stackelberg leaders.

Though the above-mentioned papers do not control free-riding in a strict sense, most models come to the pessimistic conclusion that only two or three countries will form a stable coalition. Only Barrett (1994b) finds a coalition of up to N countries in the case of linear marginal abatement and damage costs, symmetric countries, and assuming the signatories to be Stackelberg leaders. The result is confirmed in the supergame version of his model.

The approach adopted by these works has assumed a simple government objective function considering the government as benevolent. However, recent events in the United States have illustrated the extent to which organized groups condition environmental policy, both at national and multilateral levels. Industry and green lobbies have been extremely influential. On some issues, such as multilateral emissions cuts, they have held different positions. On others, such as the compliance of foreign legislation with American environmental standards, their objectives have often coincided. It is necessary, thus, to take into account the influence of these groups on environmental government decision. The purpose of our paper is to understand how the presence of green and producer lobbies can affect the international environmental agreement formation and stability.

To analyse government behaviour at the international policy, Sprinz and Vaahtoranta (1994) presented the approach of "interest based explanation" They explain that government position can be deduced from information about the country's ecological vulnerability and abatement cost. This analysis suggests that countries will act as « pushers » for substantial emission reduction when their ecological vulnerability to environmental pollution impact is

high and their abatement costs for pollutant emissions are low. In contrast, countries characterised by high abatement costs and low ecological vulnerability can be expected to act as « draggers » in such negotiation due to the low benefit-cost ratio of pursuing emission reduction. Countries with both high ecological vulnerability and high abatement cost are caught in between the former two groups as they face an "intermediate" benefit-cost ratio, while countries that are neither affected by the environmental problem nor face high abatement cost will act as bystanders in international environmental negotiation. They expect that pusher countries take more stringent environmental positions than intermediate countries do, while the latter group is expected to favour environmental protection more often than draggers. The likelihood of bystanders' supporting environmental protection should fall between those for pushers and draggers; however, no direct comparison with the intermediate group seems to be appropriate on theoretical grounds. This study give an interesting explanation to government decisions at the international level but present the same inconvenient than the previous works, it doesn't consider national political actors and their effects on government policy.

Since we are mainly concerned with a positive analysis of both coalition formation and the size of a stable IEA, we assume then that authorities, rather than seeking social welfare objectives, pursue their own self-interest motives maximizing their political support.

This paper is part of an increasing vast political economy literature which examines the influence of interest groups on policy-making. To our knowledge, rare are studies looking at the role of green and industrial lobbies on the IEAs formation and stability. A more recent body of literature, which includes Frederiksson (1997), Aidt (1998) and Conconi (2000a, 2000b, 2001) studies the political economy of environmental policy. These studies adopt the political contribution approach to analyse the impact of green and producer interest on environmental policy. The former studies treat only environmental policy when the later investigates the joint determination of trade and environmental policy. But none examines the effect of lobbing by green and producer groups on the formation and stability of IEA.

The analysis presented in this paper looks at the relationship between interest groups and policy-makers. Most studies have focused on the role of producer groups in the determination of trade policy. In this area, the political contributions approach of Grossman and Helpman (1994, 1995, 1996) has became something of a work-horse model (see Cadot et al (1997), Rama and Tabellini (1998) and Mitra (1999), among many other). A similar approach, originally developed by Stigler (1971) and Peltzman (1976), and first applied to trade policy by Hillman (1982), describes trade policy as being set by an incumbent government seeking to maximize its political support. A third approach, developed by Hillman and Ursprung (1988) and Magee et al. (1989), focuses on the electoral competition among political parties. Here lobbies do not directly affect policy choice, but do, instead, affect the probability of their favourite party to be elected. Alternatively, Austen-Smith (1997) views the policy-making process as being characterized by uncertainty. In his framework, interest groups influence the provision of informational expertise. Most studies on the political economy of trade have disregarded the environmental impact of trade and the role of green lobbies. Two notable exceptions in this respect are Hillman and Ursprung (1992, 1994), who introduced environmental lobby groups in a model of endogenous trade policy.

In order to examine the impact of green and industrial lobbies on IEAs formation and stability, we extend the analysis of Hillman (1982) using the approach that models the formation of IEAs as a two stage non-cooperative game (Carraro and Siniscalco, 1993). In the first stage, governments decide on their membership in a coalition; in the second stage, coalition members choose their abatement strategies. Governments signing the IEA form a coalition and behave cooperatively by maximizing the coalition's aggregate political support

function. Governments that do not participate in the agreement behave non-cooperatively by maximizing their individual political support function.

We organized the remainder of the paper as follows. Section 2 lays out the theoretical model. In section 3, we consider the political equilibrium under the assumption that governments maximize their political support function. In section 4, we determine the size of the stable IEAs and study the effect of taking into account lobby pressures. Finally, in section 5, we conclude and discuss some interesting extensions of the model.

2 The Model

2.1 Background:

We consider n identical countries. We focus on the political and economic structure of each country. Production in each country i, i=1…N, generates emissions that damage a shared environmental resource. In each country, we distinguish two types of individuals. First, we have the environmentalists whose current abatement benefits are assumed to depend on current total abatement as follows

$$(1) \qquad B(Q) = b(aQ - \frac{Q^2}{2}) \quad \text{avec } Q \leq a.$$

where B(Q)[1] is abatement benefit of environmentalist in country i which is the country benefit from the pollution abatement policy. a and b are positive parameters and $Q = \sum_i q_i$ is global abatement. We suppose that only environmentalists have environmental concerns and that their ideal abatement level is $q_E = \frac{a}{N}$.

Second, we have producers which are harmed by abatement decision and their abatement costs are assumed to depend on its own abatement level and no one else's. Their ideal abatement level is $q_I = 0$. The abatement cost function is assumed to be given by

$$(2) \qquad AC_i(q_i) = \frac{c}{2} q_i^2$$

Where $AC_i(q_i)$ is i's abatement cost of producer group in country i and q_i is i's abatement, such that $Q = \sum_i q_i$. This cost isn't sufficiently high to make producer profit negative.

Our model does not explain the process of lobby formation. We simply assume that only two groups of citizens overcome the free-riding problem described by Olson (1965) and get politically organized: a proportion of the population, the "environmentalists", who form a national green lobby and the industrialists, who form producer lobby. This model is first concerned with establishing the effects of political support motives on the determination of emission abatement within a two stage non-cooperative game and then the number of countries signing a stable IEA.

[1] The present benefit and cost functions specifications are those proposed by Barrett (1994).

Consider green lobby group. It gains from the increases in total (global) abatement effort, this means that an environmentalist group in a country j will support its own government when it participates to the global abatement but also even though abatement effort has been made in some country i. This means that government will be rewarded by its environmentalist group for having incited other government to participate to the collective abatement effort. But, global benefit isn't sufficient to explain why an environmentalist group is supporting its own government. We assume that it will only do so when its own government undertakes additional abatement effort. To introduce this condition, we suppose that environmentalists are harmed by the damage caused by the non-abated emissions consisting in the difference between their ideal point (q_E) and their country current abatement level (q_i). This damage allows environmentalist group to sanction its government both when it doesn't take any abatement decisions and when its abatement decision is lower than environmentalist ideal abatement level (q_E) Then the more the government abatement level is closed to the environmentalist group ideal point, the more it will be supported.

The environmentalist lobby support depends also on government decision about its participation to IEA. If government decides to participate then environmentalist lobby group considers not only national damage but also damages generated in the signatories' countries. However, if government decides not to participate to the IEA then environmentalist lobby group takes in its consideration only national damage. Therefore, we can specify environmental lobby gain function as follow:

$$g_i(q_i, q_E) = \begin{cases} B(Q) - D_i(q_i, q_E) & si\ i\ est\ non-signataire \\ B(Q) - \sum_i D_i(q_i, q_E) & si\ i\ est\ signataire \end{cases} \quad (3)$$

$D_i(q_i, q_E) = \frac{b}{2}(q_E - q_i)^2$ is the damage caused by the non-abated emissions consisting in the difference between their ideal point ($q_E = \frac{a}{N}$) and their country current abatement level (q_i).

The industrial lobby group is always harmed by the government decision of abatement level. The ideal decision for the industrial lobby is not to abate ($q_I = 0$). Its abatement cost is assumed to depend on its own abatement level and nor one else's and it takes the following form:

$$l_i(q_i) = AC_i(q_i) \quad (4)$$

The abatement level derives from maximization by authorities of their political support function.

(5) $$M_i(q_i) = M\left[g_i(q_i, q_E), l_i(q_i)\right]$$

Higher gain elicit greater political support from environmentalists which can be reflected by $M_g > 0$, but producer are harmed by higher abatement, so $M_l > 0$. To analyze the effect of lobbies' pressures on government decision we have to choice one specification of our political support function. We choice to this purpose a linear additive function of lobbies' political support. Let

$$M_i(q_i) = \rho_i g_i(q_i, q_E) - l_i(q_i)$$

With $\rho_i > 0$, ρ_i dénotes the government i's political support function such that ρ_i reflects the political strength of green over producer lobby which depends on its capacities to be organized and then to give political support to the government for its abatement decision.

The noncooperative or open access outcome can be computed by invoking the usual Cournot conjecture that each country chooses its emission level taking the other countries' emissions as given. That is, each government chooses q_i to maximize M_i. Let q_i^{nc} the non cooperative abatement level at the equilibrium such that

$$\rho_i\left[MB(Q) - MD_i(q_i^{nc}, q_E)\right] = MAC_i(q_i^{nc})$$

MB, MD_i and MAC_i represent respectively marginal benefit, marginal damage and marginal. Abatement cost. Since we have assumed complete symmetry between countries, the first order condition of the above maximization problem yields country i's abatement reaction function,

(6) $$q_i^{nc} = \frac{\rho\left[a + q_E\right]}{\left[N\rho + \rho + \lambda\right]}$$

Such that $\lambda = \frac{c}{b}$. Consequently, the aggregate abatement level under the (purely) non-cooperative case is $Q^{nc} = N.q_i^{nc} = \frac{N\rho\left[a + q_E\right]}{\left[N\rho + \rho + \lambda\right]}$ which verifies $Q^{nc} \le a$.

Under full cooperation, the grand coalition maximizes the global net benefits:

$$\sum_{i \in N} \rho_i\left[MB(Q) - MD_i(q_i^c, q_E)\right] = MAC_i(q_i^c)$$

The first order yields the aggregate abatement level, $Q^c = \frac{N^2\rho\left[a+q_E\right]}{\left[N^2\rho+N\rho+\lambda\right]}$ $(Q^c \le a)$. Since each country contributes $(\frac{1}{n})$ of the total emissions abatement, the per country abatement level is:

$$q^c = \frac{N\rho\left[a+q_E\right]}{\left[N^2\rho+N\rho+\lambda\right]} \quad (7)$$

We see immediately that $Q_c > Q_{nc}$, each country is better off at the full cooperative solution ($M_i^c\left(q_i^c\right) > M_i^{nc}\left(q_i^{nc}\right)$[2]). However, in this one stage game, purely simultaneous framework, each country has incentives to cheat on the agreement and free-ride on the emission reduction achieved by the countries complying with the agreement.

In what follows we examine the two stage framework where the incentive to free-ride on the coalition cooperating efforts may be offset by the adjustment of coalition' abatement upon a member's deviation. The equilibrium number of countries participating in an IEA is derived by applying the notions of internal and external stability of a coalition originally developed by D'Aspremont et al. (1983) and extended to IEAs by Barrett (1994). To this end we use the Hillman (1982) model of political support function. This model is first concerned with establishing the effects of political support motives on the determination of emission abatement within a two stage non-cooperative game and then on the number of countries signing a stable IEA.

2.2 Political-support Lobbies responses to IEAs

Our model is concerned with establishing the effects of political support motives on the determination of emission abatement within a two stage non-cooperative game and then on the number of countries signing a stable IEA. Suppose that it were so as assumed in Hillman (1982) that political support depends upon gainers' and losers' welfare level. Consider green lobby-specific interests. They gain as a consequence of increases in abatement level that are due to a participation in an IEA. There are more global benefit and less damage when moving from the non cooperative abatement level (status quo) to the negotiated one. The same considerations apply to industrial lobbies. They may blame with justification the authorities for welfare losses due to domestic abatement level rises that have been the consequence of participating to an IEA.

Suppose, therefore, that the political support function reflects the constituent component of abatement level, with agents responsive in their political support only to gains and losses that are due to the authorities' decisions of signing an IEA. Let $G_i(q_i, q_i^{nc})$, denotes the increase in green lobby-specific returns due to an increase in abatement level in each country. Clearly

[2] $M_i^c(q^c)$ ($M_i^{nc}(q^{nc})$) is a monotone function, it increases until q^{c*} (q^{nc*})and decrease after, such that $M_i^c(0)=\rho (q_E)^2 bN/2$ ($M_i^c(0)=\rho (q_E)^2 b/2$). As $q^{c*} > q^{nc*}$, We have always $M_i^c(q^c) \ge M_i^{nc}(q^{nc})$ ($M_i^c(q_E) = M_i^{nc}(q_E)$).

$G_{q_i} > 0$ (only when $Q < a$) and $G_{q_i q_i} < 0$. And let $L_i(q_i, q_i^{nc})$ denote the losses derived by agents harmed by the increase in abatement level in each country, relative to the abatement level they would obtain when authorities don't sign IEA, where then $L_{q_i} > 0$ and $L_{q_i q_i} > 0$. With these functions forming the basis of lobbies' political response, the political support function of authorities in country i is:

$$M_i(q_i, q_i^{nc}) = \rho_i G_i(q_i, q_i^{nc}) - L_i(q_i, q_i^{nc}) \quad (8)$$

Higher environmentalist's profits elicit greater political support from green lobby, which is reflected in $M_G > 0$, but industrial lobby is antagonized by higher abatement level, so $M_L < 0$ (Hillman, 1982)[3]. Following Hillman hypothesis, then constant verify $\rho_i > 0$.This specification considers that government objective is to maximize its own welfare, and ρ_i is a ponderation which can take low and high values following the capacity of each lobby group to influence policymaker's decisions.

More specifically, the green lobby gain is specified as a profit variation when government move from the noncooperative level to the negotiated level

$$G_i(q_i, q_i^{nc}) = g_i(q_i, q_E) - g_i(q_i^{nc}, q_E) \quad (9)$$

and the same considerations apply to the industrial lobby:

$$L_i(q_i, q_i^{nc}) = l_i(q_i) - l_i(q_i^{nc}) \quad (10)$$

Following this specification of the environmentalist and industrial lobbies' political support, the more the non cooperative abatement level is different from the negotiated one the more important is the variation of the support. Concerning the environmentalist lobby group, $G_i(q_i, q_i^{nc})$ is higher when government decides to be a signatory than when it decides to defect. In fact, the variation $g_i(q_i, q_E)$, from q_i^{nc} to q_i, is higher when government decide to sign the IEA than when it decide not to be a member. Abating q_i^s generates an important environmentalist lobby support to the signatories as global benefit is higher and damages are lower (equation (3)). Concerning industrial lobby group, the lower is the abatement cost the higher is its political support. Then the closer is the negotiated abatement level (q_i) to the non cooperative one the more government is supported.

[3] We suppose in our case that $M_{GG} = 0, M_{LL} = 0 \; and \; M_{GL} = 0$ (Peltzman eliminated also envy effect).

3 The equilibrium

In order to examine the impact of green and industrial lobbies on IEAs formation and stability, we extend the analysis of Hillman (1982) using the approach that models the formation of IEAs as a two stage non-cooperative game. Following this approach, governments facing an international environmental problem play a two-stage game. In the first stage-the coalition game- they decide non-cooperatively whether or not to sign the agreement. In the second stage, they play the non-cooperative Nash emission game, where governments, which sign the agreement, play as a single player and divide the resulting payoff according to a given burden-sharing rule.

Let us begin with analysing the outcome of the game under alternative strategic combination. First, we assume that governments decide simultaneously in both stages[4]. Second, governments are proposed to sign a single agreement. Hence, those which do sign cannot propose a different agreement. From a game theoretical viewpoint, this implies that only one coalition can be formed, the remaining defecting players playing as singletons. We also suppose that when defecting from coalitions, each country assumes that the other governments belonging to s remain in it.

Given theses assumptions, as presented by Carraro and Siniscalco (1993) we say that:

- A coalition s is stable iff:

1. There is no incentive to free-ride, i.e., $M_i^{ns}(s-1) - M_i^s(s) < 0 \ \forall i \in s$ where $M_i^{ns}(s-1)$ is country i's payoff when it defects from coalitions,

2. There is no incentive to broaden the coalition, i.e., $M_i^s(s+1) - M_i^{ns}(s) < 0 \ \forall i \in s$ [5].

- A stable coalition s is also Pareto optimal if there exist no other stable coalition which provides all countries with a payoff larger than $M_i^s(s) \ \forall i \in s$.

We suppose that a number of governments negotiate an IEA. We assume that the relative political weight (ρ) that each government gives to green lobby over industrial lobby constitute the characteristic that differs it from others. That is, we have two groups of countries which participate to the international negotiation process the signatories (ρ_s) and non signatories (ρ_{ns}). We assume that (s) governments sign an agreement and $(N-s)$ do not. Let Q^s denote the abatement level of the coalition, and q_i^s denotes the abatement of any individual signatory, such that $Q^s = sq_i^s$. In a similar manner, each non-signatory government's abatement is q_i^{ns} yielding a total abatement of all non signatories $Q^{ns} = (N-s)q_i^{ns}$ .Global abatement level is $Q = (N-s)q_i^{ns} + sq_i^s$

The non signatories behave non-cooperatively. Their maximization problem results to a best response function of the form presented earlier. Non signatory governments choose their

[4] By contrast, Barrett (1994) assumes that the group of signatories is Stackelberg leader with respect to non-signatories in the second stage emission game. In Bloch (1997) it is assumed that countries play sequentially in the first stage coalition game.

[5] This definition of stability coincides with the definition of stable cartel provided in the oligopoly literature (D'Aspremont et al, 1983) and defines the Nash equilibrium of the first stage(the one in which countries decide whether or not to sign the agreement).

abatement level on the belief that the abatement levels of all other countries are given. That is, each government chooses q_i^{ns} to maximize

$$M_i^{ns}(q_i^{ns}, q_i^{nc}) = \rho_{ns} G_i(q_i^{ns}, q_i^{nc}) - L_i(q_i^{ns}, q_i^{nc})$$

The condition describing the authorities' political support maximizing choice of abatement level is:

$$\rho_{ns}\left[MB(Q) - MD_i(q_i^{ns}, q_E)\right] = MAC_i(q_i^{ns}) \quad (11)$$

so, balancing at the margin support from green lobby who favor abatement rises against political disfavor due to industrial lobby opposition. The abatement level which solves (11) yield a maximum for (q_i^{ns}) which lies between the benefit maximizing ($Q = a$) and cost minimizing (q_i=0) abatement level.

Since we have assumed complete symmetry between governments, the first order condition of the above maximization problem yields government i's abatement reaction function,

$$q^{ns} = \frac{\rho_{ns}\left[a + q_E - Q^s\right]}{\left[\rho_{ns}\left(N - s\right) + \chi_{ns}\right]} \quad (12)$$

Where $\chi_{ns} = \rho_{ns} + \lambda$ such that $\lambda = \frac{c}{b}$. The aggregate non-signatory abatement level is $Q^{ns} = \frac{(N-s)\rho_{ns}\left[a + q_E - Q^s\right]}{\left[\rho_{ns}\left(N - s\right) + \chi_{ns}\right]}$

Signatories choose their abatement level by maximizing their collective political support function. That is, signatories choose Q^s by solving the following constrained maximization problem.

$$Max_{\left(q_1^s, \ldots, q_n^s\right)} \sum_{i \in s} M_i^s(q_i^s, q_i^{nc}) = \sum_{i \in s}\left[\rho_s G_i(q_i^s, q_i^{nc}) - L_i(q_i^s, q_i^{nc})\right]$$

where M^s is the political support function of each signatory. Then, at the equilibrium we have

$$\sum_{i \in s} \rho_s\left[MB(Q) - MD_i(q_i^s, q_E)\right] = MAC_i(q_i^s) \quad (13)$$

Thus, joining coalition s has the advantage that own abatement efforts are matched by other members and hence higher benefits and lower damages but also means higher abatement cost. To be member of the coalition means that each signatory government considers not only its damage but also all member damage. Non signatory government considers contrary only its own damages. Both effects determine whether a coalition is stable.

The first order condition yields the aggregate abatement of signatories, $Q^s = \frac{s^2\rho_s\left[a+q_E-Q^{ns}\right]}{\left[\rho_s s^2+\chi_s\right]}$, where $\chi_s = s\rho_s + \lambda$. The individual government's abatement level is,

$$q^s = \frac{s\rho_s\left[a+q_E\_Q^{ns}\right]}{\left[\rho_s s^2+\chi_s\right]} \qquad (14)$$

Proposition 1:

Each government abatement level decision depends not only on its national political process but also on the political process in the foreign country. The signatory and non signatory government individual abatement level, take the following form

$$q^s = \frac{s\rho_s\chi_{ns}\left[a+q_E\right]}{s^2\rho_s\chi_{ns}+\left(N-s\right)\rho_{ns}\chi_s+\chi_s\chi_{ns}} \quad et \quad q^{ns} = \frac{\rho_{ns}\chi_s\left[a+q_E\right]}{s^2\rho_s\chi_{ns}+\left(N-s\right)\rho_{ns}\chi_s+\chi_s\chi_{ns}}$$

Like the previous two cases where $q^{nc} > 0$ and $q^c > 0$ always holds, in the coalition formation case we have always $q^s > 0$ and $q^{ns} > 0$ which guarantees that our solutions are interior. The remaining problem is to determine the number of signatories to the self-enforcing IEA.

4 The size of stable IEAs

We now proceed with the determination of the size of the stable IEA, denoted by s*, using the internal and external stability conditions. Recall that the internal stability condition ensures that if a government were to defect unilaterally, its gains from free riding would be outweighed by the adjustment (due to its defection) of abatement levels of the remaining members of the IEA. The external stability condition ensures that no other non signatory government finds it beneficial to unilaterally join the IEA; formally, the internal and external stability conditions satisfy this definition:

Definition: *An IEA consisting of s signatories is self-enforcing if*

$$M^s(s^*) > M^{ns}(s^*-1) \quad et \quad M^s(s^*+1) < M^{ns}(s^*)$$

To analyse government behaviour at the international negotiations and its decision to participate to the IEA, we first use the approach of "interest based explanation" of international environmental policy proposed by Sprinz and Vaahtoranta (1994). Then, government position can be deduced from information about the country's ecological

vulnerability (b) and abatement cost(c). By combining this two indicators, government can be classified into four categories as follow:

Figure 1: Prediction of interest-based explanation from government negotiating position

		ecological vulnerability	
		Low	High
abatement cost	Low	Bystanders	Pushers
	High	Draggers	Intermediates

Sources : Sprinz and Vaahtoranta 1994, 8

This analysis suggests that countries will act as « pushers » for substantial emission reduction when their ecological vulnerability to environmental pollution impact is high and their abatement costs for pollutant emissions are low. In contrast, countries characterised by high abatement costs and low ecological vulnerability can be expected to act as « draggers » in such negotiation due to the low benefit-cost ratio of pursuing emission reduction. Countries with both high ecological vulnerability and high abatement cost are caught in between the former two groups as they face an "intermediate" benefit-cost ratio, while countries that are neither affected by the environmental problem nor face high abatement cost will act as bystanders in international environmental negotiation.

We expect that pusher countries take more stringent environmental positions than intermediate countries do, while the latter group is expected to favour environmental protection more often than draggers. The likelihood of bystanders' supporting environmental protection should fall between those for pushers and draggers; however, no direct comparison with the intermediate group seems to be appropriate on theoretical grounds. To simplify our presentation we suppose that b and c take three values (0.01, 1,100).

This interest-based perspective on international environment regulation offers a partial but parsimonious view of how government's decisions to participate to the international environmental agreements are shaped. The interest based explanation allows an initial understanding of possible positions taking by countries in international environmental negotiations. Many factors influence governmental position in the international negotiations. As the study by Weiss and Jacobson (1998) demonstrates, country-specific factors such as the wealth of a country, the domestic institutional structure, and the political strength of environmental NGOs vis-à-vis major polluting industries influence government participation to IEA.

Then, ecological vulnerability and abatement cost can not be sufficient to explain government behaviour. Government decision about its participation to the international environmental agreement depends on the types of its domestic political actors and their interest. Theses interests can be represented respectively by industrial and environmental lobby group. The influence of these actors is measured by ρ_s and ρ_{ns} respectively in the signatories and in the non signatories countries. Tables 1-4 present solution to s* for various values of b, c, ρ_s and ρ_{ns} when n=100, a=1000. Simulation shows that the number of signatories to the self-enforcing IEA varies not only with b and c but also depends on the strength of environmentalist vis-à-vis major polluting industries in both signatories' and non signatories' countries. High ρ_s (1,5; 2) means that government give more weight to the environmental lobby group support, that is, this group is more able to be organized and to

influence government decision. Inversely, when ρ_s is low (0,2; 0,5) this means that industrial lobby group is more able to influence government decision. ρ_s =1 means that government is indifferent between environmental lobby group and industrial lobby group.

We test all coalition structures for stability using our political economy model. We can observe that once governments include in their decisions the level of political lobby support the stability and the size of coalition increase. More specifically, when signatories are expected to be more influenced by environmental, stable coalition, if it exists, is of size 2. There are only internally stable coalitions, but none of these is externally stable. The situation does not improve much when signatories are indifferent between the two existing lobbies, in this case only one possibility gives a stable coalition, that is, when non-signatories are influenced by environmental lobby group and then s*=2 or 9.

If signatories decide to accept only the contributions of the industrial lobby, the stable coalition emerges independently of which lobby group is able to influence non signatories' decision. In this case, except for identical countries, there are no non-trivial stable coalitions in our different scenarios. Among these, the grand coalition (i.e. an agreement of all countries) is stable.

Proposition 2:

Once governments include in their decisions the level of political pressure that the lobby groups exert, stability and size of coalition increase. Basically, industrial lobby support reduces the incentive of free riding and can incite signatory governments to sustain the grand coalition when the non signatory government have different national political support.

However, the extent of this improvement is determined mainly by each government abatement cost and benefit characteristics. To this end we consider the situation in which we have stable coalitions. That is, we consider the case in which signatories are more influenced by industrial lobby group than by environmental lobby group. More specifically we will analyze the scenario ρ_s =0.5 and ρ_{ns}=1.5.

Table 1: The size of stable coalition when ρ_s =0.5 and ρ_{ns}=1.5.

		b: ecological vulnerability		
		0.01	1	100
c: abatement cost	0.01	Grand coalition	Grand coalition	Grand coalition
	1	19	Grand coalition	Grand coalition
	100	11	19	Grand coalition

From the table 1 we observe that, when signatories are more supported by industrial lobby group whereas non signatories are instead more supported by environmental lobby group, a self-enforcing international environmental agreement is stable. Nevertheless, the size of this stable IEA depends of the cost benefit structure of the government.

In this case, when governments are expected to behave as pushers, the stable coalition which emerges is a Grand coalition. Given that ecological vulnerability is higher than abatement costs, an IEA sustains also large number when signatories continue to be influenced by

industrial lobby group. Indeed, if governments (signatories and non signatories) expected to behave as Pushers, have industrial support such non signatories governments are more supported nationally by their environmental lobby group than signatories one (ρ_s = 0,2; ρ_{ns} =0.5) the size of stable coalition is s*=18. When governments are expected to behave as Intermediates or Bystanders they enjoy a maximum political support level when the size of stable coalition is also large (grand coalition). This happens independently of which lobby group influence non signatory decision. Finally, when governments face high cost and are not very ecologically vulnerable, that is, when they are expected to behave as draggers, the size of stable coalition which correspond to the maximum level of national political support is the smallest one compared to the others governments types, s*=11 or 19. Indeed, when non signatories give more weight to environmental lobby than signatories then Draggers Prefer not to leave the IEA.

Table 2: Government political support (signatories and non signatories) for each value of b and c under the IEA outcome (ρ_s =0.5 and ρ_{ns}=1.5).

		b: ecological vulnerability		
		0.01	1	100
c: abatement cost	0.01	0,9236 0,5155	0.0096 0.0065	9.6006 e-5 6.5301 e-5
	1	689.8738 717.4429	92,3461 51.5520	0.9603 0.6507
	100	55.4156 63.2910	6.8987 e+4 7.1744 e+4	9,2356 e+3 5.1552 e+3

Table 2 shows the different level of payoff function for each type of government in the situation in which they all enjoy industrial lobby group support. The analysis of this result shows that Draggers are the more gainer when they participate to the international environment agreement. They enjoy a high level of political support when they sustain a small stable IEA. Those who gains the least are Pushers. When they participate to grand coalition, they gain less compared to bystanders and intermediate who decide to form a large coalition and less than draggers who prefer to free-ride (s*=11 or 19).

Proposition 3:

Pusher countries take more stringent environmental positions than intermediate countries do, while the latter group favour environmental protection more often than draggers. The likelihood of intermediate and bystanders' supporting environmental protection globally fall between those for pushers and draggers.

The most important result given by our simulation is that an IEA can avoid the problem of free riding and sustain a large number of signatories (Grand coalition). This is the case when governments are more influenced by industrial lobby group. This grand coalition can be explained by the fact that governments which were non signatory will abate less when and become signatory and form the grand coalition than in the non cooperative situation.(Table

3a, 3b). In this situation the signatory government will abate their cooperative abatement level when the grand coalition is formed.

Table 3 a: Abatement level of respectively signatories and non signatories governments for each value of b and c under the IEA outcome

		b: ecological vulnerability		
		0.01	1	100
c: abatement cost	0.01	9.9980*	10	10
		6.1188	9.9357	9.9994
	1	9.7868	9.9980	10
		3.8815	6.1188	9.9357
	100	0.5446	9.7868	9.9980
		0.1486	3.8815	6.1188

* means that qs=9,9980 and qns=6.1188

Table 3 b: Cooperative and non cooperative abatement level of signatories and non signatories governments (q_c and q_{nc}) for each value of b and c under the IEA outcome

		b: ecological vulnerability		
		0.01	1	100
c: abatement cost	0.01	9,9980 / 9,8058	10 / 9,9980*	10 / 10
		9,9993 / 9,9344	10 / 9,9993	10 / 10
	1	9,8058 / 3.3555	9,9980 / 9,8058	10 / 9,9980*
		9,9344 / 6,0239	9,9993 / 9,9344	10 / 9,9993
	100	3.3555 / 0,0502	9,8058 / 3.3555	9,9980 / 9,8058
		6,0239 / 0,1492	9,9344 / 6,0239	9,9993 / 9,9344

* means that for he signatories qc=10 and qnc=9,9980, and for the non signatories qc=10 and qnc=9,9993

Intermediate and bystanders, when they participate to the IEA, abate more than in the Non cooperative situation. However, this difference is small which may explain why coalition can sustain a large number of signatories.

When λ is high and particularly when c is very high the difference in individual abatement under Full cooperation and Non cooperative outcome is trivial which explains the small size of stable coalition and the behaviour of free riding adopted by draggers.

5 Conclusion:

This paper has shown that self-enforcing international environmental agreements (IEA), which establish rules for managing shared environmental resources may sustain a large number of signatories, that is, may be able to improve substantially upon the non cooperative outcome.

To prove this result, we have employed a political economy model in witch green and producer lobbies participate in the determination of environmental policy. In contrast to the existing literature, in this paper, the international environmental negotiation has been considered beginning from the premise that authorities will choose abatement levels on the basis of political support motives. So not perceptions of social justice, but rather the authorities' perceptions of their own political self-interest determine the environmental policy. To portray politically motivated interventionist behavior, we have adopted Hillman model originally presented in Stigler-Peltzman regulatory model to view the beneficiaries of gainers and losers from government participation to IEAs.

The basis conclusion that emerges from the analysis of politically motivated coalition formation decision depends not only on values taken by λ ((b/c)) but also on the political strength of green lobby over industrial lobby (ρ) which depends on its capacities to be organized and to give political support to the government for its abatement decision.

We used the "interest based explanation" to have explanation of support for international environmental negotiation. Operationalized as the degree of ecological vulnerability (b) and cots of abatement (c), we expected that countries could be typified as pushers, intermediates, draggers and bystanders in international environmental negotiation. We find that we have different type of governments corresponding to each one. Therefore, we conclude that government decision about IEA depends not only on λ but also on domestic political factors. Industrial and environmental lobbying effort could each play an important role.

It is more probably to see draggers who deviate from IEA when as signatories are more supported by industrial lobby group than non signatories. Then the self-enforcing international environmental agreement will not be able to sustain more than 2 countries which confirm previous literature. In contrary, pushers are the most incited one to participate to the self-enforcing IEA when as non signatories are more supported by environmental lobby group than signatories. The self-enforcing IEA will be signed by a lot of countries when abatement costs are low and ecological vulnerability are high ($\lambda \leq 1$) and signatory and non-signatory governments are more supported by industrial lobby than environmental lobby (Pusher) or both are supported by industrial lobby group (Bystanders). In contrast, with the same national political support when countries are characterised by high abatement costs and low ecological vulnerability (draggers, $\lambda > 1$) then a self-enforcing IEA may not be able to sustain more than 2 signatories government..

Nevertheless, usually we found that Pusher countries will always take more stringent environmental positions than intermediate countries do, while the latter group favour environmental protection more often than draggers. The likelihood of bystanders' supporting environmental protection globally falls between those for pushers and draggers; however, no direct comparison with the intermediate group seems to be appropriate.

6 Bibliography

Aidt, T. S. (1998). "Political Internalization of Economic Externalities and Environmental Policy", Journal of Public Economics 69, 1-16.

Austen-Smith, D. (1997). "Endogenous Informational Lobbying", Fondazione ENI Enrico Mattei, Nota di Lavoro 27/97.

Barrett, S. (1994a), `The Biodiversity Super game', Environmental and Resource Economics, 4, 111-122. Game Theory and International Environmental Cooperation 87

Barrett, S. (1994b), `Self-Enforcing International Environmental Agreements', Oxford Economic Papers, 46, 804-878.

Bauer, A. (1992), International Cooperation over Greenhouse Gas Abatement, Munich, Germany: Mimeo of the Seminar für empirische Wirtschaftsforschung, University of Munich.

Bohm, P. and Larsen, B. (1993), `Fairness in a Tradable-Permit Treaty for Carbon Emissions Reductions in Europe and the Former Soviet Union', Environmental and Resource Economics, 4, 219-239.

Cadot, O., de Melo, J. and Olarreaga, M. (1997). "Lobbying and the Structure of Protection", CEPR Discussion Paper No. 1574.

Carraro, C. and Siniscalco, D. (1992), international dimension of environmental policy. European Economic Review 36 :379-387.

Carraro, C. and Siniscalco, D. (1993), `Strategies for the International Protection of the Environment', Journal of Public Economics, 52, 309-328.

Chander, P. and Tulkens, H. (1992), `theoretical foundations of negotiations and cost sharing in transfrontier pollution problems. European Economic Review 36 :388-398.

Chander, P. and Tulkens, H. (1995), `A Core-Theoretic Solution for the Design of Cooperative Agreements on Transfrontier Pollution', International Tax and Public Finance, 2, 279-293.

Conconi, P. (2000). "Can Green Lobbies Replace a World Environmental Organization-?", Fondazione Eni Enrico Mattei Note di Lavoro: 56/2000.

Conconi, P. (2001). "Green Lobbies, Transboundary pollution, and International Trade", Submitted to EPCS annual meeting, in Paris.

Conconi, P. (2000). "Green and Producer Lobbies: Enemies or Allies?", Working Paper No: 570. Warwick University.

D' Aspremont, C.A., Jacquemin, J., Gabszeweiz, J., and Weymark, J.A (1983), `On the stability of collusive price leadership', Canadian Journal of Economics, 16, 17-25.

Fankhauser, S. and Kverndokk, S. (1996), `The Global Warming Game -- Simulations of a CO2 Reduction Agreement', Resource and Energy Economics, 18, 83-102.

Folmer, H., Hanley, N. and Mibfeldt (1998), `Game- theoretic modelling of environmental and resource problems: an introduction'. In Nick Hanley and Henk Folmer (ed): Game theory and environment, chp1, pp 1-29. EE, Cheltenham, UK.

Fredriksson, P. (1997). "The Political Economy of Pollution Taxes in a Small Open Economy", Journal of Environmental Economics and Management 33, 44-58.

Fredriksson, P. (1999). "The Political Economy of Trade Liberalization and Environmental Policy", Southern Economic Journal 65, 513-525.

Grossman, G. M. and Helpman, E. (1994). "Protection for Sale", American Economic Review 84, 833-850.

Grossman, G. M. and Helpman, E. (1995). "Trade Wars and Trade Talks", Journal of Political Economy 103, 675-708.

Grossman, G. M. and Helpman, E. (1996). "Electoral Competition and Special Interest Politics", Review of Economic Studies 63, 265-286.

Hillman, A. L. (1982). "Declining Industries and Political-Support Protectionist Motives», American Economic Review 72, 1180-1187.
Hillman, A. L., and Ursprung, H. W. (1988). "Domestic Politics, Foreign Interest and International Trade Policy", American Economic Review 78, 729-745.
Hillman, A. L., and Ursprung, H. W. (1992). "The Influence of Environmental Concerns on the Political Determination of Trade Policy," in K. Anderson, and R. Blackhurst (eds.), The Greening of World Trade Issues. Harvester Wheatcheaf, New York.
Hillman, A. L., and Ursprung, H. W. (1994). "Greens, Super greens, and International Trade Policy: Environmental Concerns and Protectionism", in C. Carraro (ed.), Trade, Innovation, Environment. Kluwer Academic, Dordrecht.
Hoel, M. (1992), `International Environment Conventions: The Case of Uniform Reductions of Emissions', Environmental and Resource Economics, 2, 141-159.
Kaitala, V., Pohjola, M. and Tahvonen, O. (1992), Transboundary air pollution and soil acidification : a dynamic analysis of an acid rain game between Finland and USSR. Environmental and resource economics 2 : 161-181.
Mäler, K.-G. (1989), `The Acid Rain Game', in Henk Folmer and E. van Ierland (eds), Valuation Methods and Policy Making in Environmental Economics, Amsterdam, The Netherlands: Elsevier, pp. 231-252.
Mitra, D. (1999). "Endogenous Lobby Formation and Endogenous Protection: A Long-Run Model of Trade Policy Determination", American Economic Review 89, 1116-1134.
Newbery, D. (1990), Acid rain. Economic policy 5: 287-346.
Olson, M., (1965), The Logic of Collective Action. Harvard University Press, Cambridge, MA.
Peltzman, S. (1976). "Toward a More General Theory of Regulation", Journal of Law and Economics 19, 211-240.
Rama, M., and G. Tabellini (1998). "Lobbying by Capital and Labor over Trade and Labor Market Policies", European Economic Review 42, 1295-1316.
Sprinz, D. and T., Vaahtoranta. (1994). " The interest-based explanation of International Environmental Policy". International Organization, 48(1):77-105.
Stigler, G. J.,(1971). "The theory of economic regulation". Bell Journal of Economics, Spring, 2, 3-21.
Tahvonen, O. (1994), `Carbon Dioxide Abatement as a Differential Game', European Journal of Political Economy, 10, 685-705.
Welsch, H. (1992), inequality aspects of alternative CO2 agreement designs. OPEC review 16 :23-36.
Welsch, H. (1995), `Incentives for forty-five Countries to Join Various Forms of Carbon Reduction Agreements', Resource and Energy Economics, 17, 213-237.