

Lobbies Competition and Bilateral International Environmental Agreements

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This paper analyzes two small open economies that share a natural environment and consider an environmental agreement between them. The two governments do not merely maximize general welfare in their respective countries, but also pick a policy partially in response to their internal “functionally specialized” industrial and environmental lobbies. This paper provides the conditions under which an International Environmental Agreement (IEA) between those two countries could be achieved in a subgame-perfect equilibrium with or without special interests’ pressures.

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I. Introduction

The standard theory tells us that it is difficult to expect cooperative action in an internationally shared environment because it is a prisoner’s dilemma, and therefore, it is in a country’s best interest to act independently. However, many authors have tried to explain why cooperation has often been observed in this prisoners’ dilemma against the standard theory. (e.g., Guttman, 1978; Hoel, 1991; Carraro and Siniscalco, 1993; Barrett, 1994a, 1997). However, these authors have developed their arguments on the basis of the assumption that a nation is a homogeneous entity and the governmental agency responsible for negotiating an international agreement always tries to maximize its domestic social welfare. By contrast, this paper explores the conditions required for achieving an International Environmental Agreement (IEA) on the basis of the more realistic assumption that various interests could collide when forming a policy and that the governmental agency in question is

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actually a politically elected individual. There are many authors who analyze the domestic environmental policy formation in the lobby competition framework. (e.g., Fredriksson, 1997; Aidt, 1998; Conconi, 2003; Fredriksson et. al., 2005) However, there are not many that try to understand an international environmental negotiation in a political economy framework.

Putnam (1988) notes that a governmental agency sitting at an international negotiation table is faced with a two-level game and needs to go back and forth between domestic politics and the international negotiation. Thus, domestic politics plays a strong role in the process of an international negotiation. Anderson (1991) indicates that a government under political pressure leads to globally suboptimal outcomes because of many politically unorganized and unrepresented interests. Barrett (1998) notes, acknowledging Putnam (1988), that the process as well as the outcome matters and the process can change the rules of the game and the outcome.

Siqueira (2003) provides a formal model in which the governmental agency responsible for negotiating an IEA is elected by a majority rule. He shows that in two countries setting voters tend to elect a more aggressive government and the environmental outcome could be inferior to the one only with politically neutral agencies. Buchholz, et. al. (2005) draw a similar conclusion based on a median voter model. They argue that citizens tend to elect a less greener negotiating agency than they are, making the IEA just codifying a non-cooperative outcome. Kemp and Rossignol (2008) consider a strategic voting in a similar model to show that their suggested several agreements may or may not be reached.

On the other hand, there are several authors who try to understand the nature of an IEA in the framework of lobbies' competition. Altamirano-Cabrera (2007) analyzes a cartel formation for an international climate policy in an n -country setting with two lobbies in each country. Habla and Winkler (2011) analyzes whether two countries can come to set up an international permit market for GHG emissions under multiple lobbies' competition. The present paper also follows this line of analysis. We study the condition for an IEA between two countries with two lobbies in each country. Our framework can be useful for understanding regional IEAs between two neighboring countries, like between Korea and China or between US and Canada.

This paper analyzes a two-stage game. In the first stage, the relevant lobbies in each country compete for pushing through or preventing an IEA. In the second stage, the governmental agencies either sign an IEA or not. For the purpose of this paper, it is assumed that there are only two kinds of lobbies, industrial and environmental, and that they are all "functionally specialized" (Aidt, 1998). That is, the industrial lobby cares only about the profits of its members and the environmental lobby cares only about environmental damages to member consumers. The governmental agency is concerned with the monetary contributions from the lobbies as well as the nation's general welfare. With this framework, this

paper tries to identify the conditions under which a politically viable IEA could evolve.

The paper proceeds in the following order. Section 2 presents a simple two-country two-goods model. Section 3 analyzes the conditions under which an IEA could evolve in an equilibrium of the game. Lastly, section 4 presents some concluding remarks.

II. The Model

2.1. The Domestic Economy

We consider two sovereign countries, $i = 1, 2$, that share a natural environment. Each country has a small open economy with only two sectors.¹ It is assumed that free trade prevails in both markets and the two countries are just price takers in those markets.² One sector produces non-polluting numeraire good z and the other produces x with a pollutant in the production process. This pollutant degrades the environment shared by the two countries. Labor is the only input for producing z with a constant-returns-to-scale technology. The labor market is assumed to be perfectly competitive with the equilibrium wage rate as 1. On the other hand, the polluting sector uses two production inputs: labor and sector-specific capital goods. Profit maximization leads to the profit function $\pi(p)$ where p represents the price to the producer. By Hotelling's lemma the supply function is $\partial\pi / \partial p = X$. The emission rate is constant at θ and thus, the total emission is $e = \theta X$. A tax t is imposed per unit of emission, resulting in the tax revenue of $\tau(t) = t\theta X$. The world market price is given as p^* , and so it follows that $p = p^* - t\theta$.

There are three types of citizens - workers, environmentalists, and industrialists. All citizens have a similar quasi-linear utility function and equal amounts of labor endowment. The total labor endowment is assumed to be l . However, it is assumed that only the environmentalists are concerned with the quality of the environment and only the industrialists receive an income from the sector-specific capital. Within this framework, it is further assumed that the only environmental policy instrument in play is a unit pollution tax. The total tax revenue is distributed equally among all the citizens. A typical environmentalist chooses the consumption of two goods c_z, c_x to maximize his or her utility, subject to a budget constraint as

¹ The country specific subscripts will be omitted until necessary.

² The environmental policy may be strategically set for trade benefit. (Barrett, 1994b; Conconi, 2003) Here, however, it is assumed away just for the sake of the paper's focus. The countries may be small in world markets and they may not export much to each other.

presented in the following mathematical set-up (1). In it, the disutility from pollution is assumed to be proportional to the amount of pollution and comes from the other country's emission as well as its own. Notice here that the population is normalized to 1 and the individual labor income and tax rebate are l and τ , respectively.

$$\begin{aligned} U^E &= c_z + u(c_x) - \theta_1 X_1 - \theta_2 X_2 \\ \text{s.t. } l + \tau &= c_z + p^* c_x \end{aligned} \quad (1)$$

Utility maximization leads to a demand function for the polluting good $d^x(p^*) = u'^{-1}(c_x)$ and the demand function for the numeraire good $d^0(p^*) = (l + \tau) - p^* d^x(p^*)$. Thus, the indirect utility for an environmentalist $V^E = (l + \tau) + u(d^x(p^*)) - p^* d^x(p^*) - (\theta_1 X_1 + \theta_2 X_2)$. Notice here that $u(d^x(p^*)) - p^* d^x(p^*)$ is the consumer surplus from consuming x . In the same manner, we can consider the worker's and the industrialist's optimization problem. The industrialist's problem is described in the following set-up (2) where α^I represents the population of industrialists.

$$\begin{aligned} U^I &= c_z + u(c_x) \\ \text{s.t. } l + \tau + \pi / \alpha^I &= c_z + p^* c_x \end{aligned} \quad (2)$$

Finally, the worker's problem is as follows :

$$\begin{aligned} U^W &= c_z + u(c_x) \\ \text{s.t. } l + \tau &= c_z + p^* c_x \end{aligned} \quad (3)$$

The indirect utility functions for an industrialist and a worker are $V^I = \pi / \alpha^I + u(d^x(p^*)) - p^* d^x(p^*)$ and $V^W = (l + \tau) + u(d^x(p^*)) - p^* d^x(p^*)$, respectively. So the social welfare function $W^S (\equiv \alpha^E V^E + \alpha^I V^I + (1 - \alpha^E - \alpha^I) V^W)$ is as in the following equation (4) where α^E stands for the population of environmentalists.

$$W^S = l + \tau(t) + \pi(p) + CS(p^*) - \alpha^E (\theta_1 X_1 + \theta_2 X_2) \quad (4)$$

where $CS(p^*)$ represents the consumer surplus from consuming x . Notice W^S depends on the tax rate set by the other country as well as the rate set domestically.

2.2. The Common Environment

As mentioned previously, the environmental quality enjoyed by one country is influenced by pollution caused by the other country as well as itself. Without cooperation, each country would emit, ignoring its effects on the other country's welfare and the resultant pollution level would far exceed the global optimum. To see this, it is assumed that the two countries stay in the non-cooperative Nash equilibrium without any lobbies towards government politicians as a status quo in our analysis. In mathematical terms, the two countries set tax rates (t_1^N, t_2^N) that maximize their respective social welfare functions (4) for the status quo. The first order conditions are the following (5). For each i ,

$$\frac{\partial W_i^S}{\partial t_i} = (\alpha_i^E - t_i)\theta_i^2 \frac{dX_i}{dp} = 0 \quad (5)$$

In other words, in this particular model each country sets its pollution tax rate at the population of environmentalists in its own country. This can be interpreted as the independent Pigouvian taxation (Fredriksson, 1997).

Now, let us suppose that the stakeholders in the two countries know that there is an alternative option that the countries can cooperate to improve the common environment better than the status quo. The cooperation can be expressed as coordinated pollution tax rates. Now, for both sides to come to an IEA, the effect of one country's (country i) action on the other country's (country j) welfare as $\frac{\partial W_j^S}{\partial t_i}$ should be taken into consideration at the time of setting the first country's tax rate. In mathematical terms, for each $i \neq j$

$$\frac{\partial W_i^S}{\partial t_i} + \frac{\partial W_j^S}{\partial t_i} = (\alpha_i^E - t_i)\theta_i^2 \frac{dX_i}{dp} - \alpha_j^E \frac{dX_i}{dp} (-\theta_j) = 0 \quad (6)$$

From (5) and (6) it is clear that the tax rates in the two countries should increase in the agreement from the status quo with either a convex or a linear supply function. So, we could say that the coordinated tax rate t_i should be strictly greater than the status quo tax rate t_i^N for all $i=1,2$. Then, to what extent should the tax rate in each country increase? That depends on the international negotiations and domestic politics within the country.

Whether an agreement has been made or not affects the various constituents differently. An agreement would imply that the tax rate is to be increased, thereby decreasing the industrialists' profits while improving the environmental quality to benefit the environmentalists. In this situation, a number of assumptions are put into play. First, it is assumed that the industrialists and environmentalists form their

respective lobbies to protect their interests by exerting political influence on the governmental agency negotiating the IEA. However, the workers are assumed not to form any lobby. Furthermore, the industrialists and environmentalists are assumed to have overcome the free rider problem to form their lobbies. Each lobby collects the money gift from its members and each member shares the cost burden equally. Also, the membership is assumed as exogenously fixed.³ Second, the negotiating governmental agency is assumed to be partially politically sensitive. In other words, the elected agency is concerned with its reelection or continuation of office. So the government cares about lobbies' giving campaign money as well as the general voter's welfare. Thus, the agency is involved in a two-level game (Putnam, 1988). In other words, the agency goes back and forth between the domestic politics and international negotiation table.

2.3. The Game

The situation we analyze can be summarized as a two-stage game. In the first stage, the lobbies in each country set their contribution schedules simultaneously in a non-cooperative manner given their common expectations of the negotiated outcome and we denote the environmental and industrial lobby's contribution by C^E, C^I , respectively. Notice here that the contribution is not a number but a schedule, in fact a two-dimensional vector with the first coordinate for retaining status quo and the second for signing on an agreement. For example, the environmental lobby offers $C^E \equiv (C^{EA}, C^{EN})$ where A, N stand for signing on an agreement and not signing on, respectively. The environmentalists and the industrialists select a contribution schedule to induce the negotiating agency to pick their respective preferred regime, i.e., signing on the agreement and not signing on, respectively. In other words, by presenting proper contribution schedules, the industrialists and environmentalists try to maximize the group utility (as expressed in (7) and (8), respectively) minus the contribution.

$$W^I = \alpha^I [I + \tau(t)] + \pi(p) \quad (7)$$

$$W^E = \alpha^E [I + \tau(t) - (\theta_1 X_1 + \theta_2 X_2)] \quad (8)$$

In the second stage, politicians in the two countries, given the lobbies' contributions, sit at the international negotiation table to decide whether to sign on

³ In practice the free rider problem may be severe and it is interesting to endogenize the cost sharing and membership. (See for example, Grossman and Helpman, 2001) Even though this is an important topic, it's not our focus in this paper. Thus, following the other authors in the literature (Grossman and Helpman, 1994; Fredriksson, 1997; Aidt, 1998) we just assume away the problems.

an agreement.⁴ The agency is assumed to maximize the following objective function (9) as the weighted sum of campaign gifts and social welfare

$$\sum_L C^L + aW^S \text{ for } L \in \{I, E\} \quad (9)$$

The agency would sign on an agreement if $\sum_L C^L(t) + aW^S(t) \geq \sum_L C^L(t^0) + aW^S(t^0)$, where t^0, t stand for the status quo reference and the cooperated tax rate, respectively (Grossman and Helpman, 1994, 1995).

The subgame-perfect equilibrium of this game is the combinations of lobbies' contribution schedules and governments' choices, which will be described in detail in the following section.

III. Equilibrium Agreement

Notice that the lobbies' utilities are sensitive to their expectations of the negotiated outcome. So, for an agreement to be made, the expectation of the two countries should be mutually consistent. Otherwise, the negotiations could break down and might have to start all over again with new expectations and contribution schedules. In addition, coming to an agreement by signing on a negotiated outcome is the sovereign decision of each country. Grossman and Helpman (1995) analyze the conditions under which a free trade agreement between two independent countries can be reached. They invent a concept called a unilateral stance, which refers to the stance a country can take, independent of the other country, to determine the fate of the agreement. So, the conclusion of a free trade agreement would depend on the unilateral stance for both countries. If we apply for this paper, then for a proposal (i.e., a combination of tax rates) to be accepted as an IEA, it would be a sovereign decision of each country. In other words, the negotiated outcome with consistent expectations should be in the domestic political equilibrium for each country. This can be summarized in the form of the following definitions.

Definition 1: Unilateral Stance (Grossman and Helpman, 1995)

Given the expectation of coordinated tax rates, a regime $R \in \{A, N\}$ is a unilateral stance for a country if there exists a set of contributions (C^E, C^I) that satisfy the following conditions, where C^{LR}, W^{LR} stands for the contribution and welfare of lobby L under regime R , respectively.

⁴ This is an example of menu auction where schedules are bid and the auctioneer picks one value out of the schedule. Bernheim and Whinston (1987) has characterized the equilibrium actions in a menu auction for the first time.

- (i) $C^{LR} \geq 0$ for $L = E, I, R = A, N$
- (ii) $C^{LR} \leq \max(0, W^{LR} - W^{LK})$ for $L = E, I, R = A, N, K = A, N, R \neq K$
- (iii) $\sum C^{LR} + aW^{SR} \geq \sum C^{LK} + aW^{SK}$ for $L = E, I, R = A, N, K = A, N$
- (iv) There is no contribution \hat{C}^L and no regime R' such that
- (a) $\hat{C}^{LR'} + C^{L'R'} + W^{SR'} \geq \hat{C}^{LK} + C^{L'K} + W^{SK}$
- (b) $W^{LR'} - \hat{C}^{LR'} > W^{LR} - C^{LR}$
- for $L' = E, I, L \neq L', R' = A, N, K = A, N$

Condition (i) requires that all the contributions are non-negative. Condition (ii) says that a contribution should be either equal to zero or not exceeding the maximum extra benefit under the regime a lobby contributes for. Notice that the industrial (environmental) lobby loses under an agreement (status quo), respectively. Thus, $C^{IA} = C^{EN} = 0$. Condition (iii) requires that the politician's welfare be maximized. Lastly, condition (iv) requires that there be no opportunity for a lobby to change its contribution in a way that its own welfare and that of the politician could be improved simultaneously. Now we can define an equilibrium agreement as follows.

Definition 2 : Equilibrium Agreement

An equilibrium agreement comprises of a combination of tax rates if (1) the countries' mutual expectations are realized in the tax rate and (2) signing on the agreement with the combinations of tax rates is the unilateral stance for each country simultaneously.

One obvious case for being able to reach an agreement is that the industrialists suffer from relatively small losses under the agreement, as even without the environmentalists' effort, any contribution opposing the agreement is not in the industrialists' interest. The industrial lobby would not invest in opposing the agreement by more than its extra benefit under the status quo. If the industrial lobby's maximum contribution is not greater than a times the general welfare (i.e., the politician's welfare without any contributions from the lobbies), the industrial lobby would not contribute any even for the status quo because it knows the general welfare is maximized under an IEA (please, refer to (4) and (9)) and the government would sign on the agreement anyway. Knowing this, the environmental lobby would not contribute either. In other words, in this situation, the lobbies would not compete and the government would endorse the agreement. This obvious case is summarized by the following proposition 1.

Proposition 1

A negotiated tax rate (t_1, t_2) would be coordinated into the IEA even without any contributions from the lobbies in both countries if (1) the lobbies' expectations in the two countries are fulfilled in (t_1, t_2) and (2) for each country i the industrial lobby's extra benefit under the status quo is so small that the following inequality holds.

$$(\pi_i(t_i^N) - \pi_i(t_i)) < \left(\frac{a_i + \alpha_i^I}{a_i + 1}\right)(\tau(t_i) - \tau(t_i^N)) + \frac{a_i \alpha_i^E}{(a_i + 1)} (\theta_i \sum_k (X_k(t_k^N) - X_k(t_k)))$$

Proof: Recall that the industrial lobby in each country would not invest campaign money for preventing the agreement beyond $(W^{IN} - W^{IA})$. If $a(W^{SA} - W^{SN}) > (W^{IN} - W^{IA})$, then the industrial lobby would not invest at all because it knows that the politician would sign on the agreement anyway. Aware of this, the environmental lobby also would not invest either. The inequality $a(W^{SA} - W^{SN}) > (W^{IN} - W^{IA})$ can be rearranged, using the equations (4) and (7), to the inequality in the proposition. QED.

In proposition 1, the right hand side of the inequality consists of two parts. One is related to the tax revenue increase due to the agreement and the other one is related to the avoided environmental damage also due to the agreement. The fact that the weighted sum of these quantities is greater than the profit-loss due to the agreement in both countries provides the condition under which an IEA could be signed on without any contributions from the lobbies. The weights as well as the two quantities (i.e., tax revenue and environmental benefit) are important in determining the weighted sum. Notice that a is less than 1 and the weight given to the tax revenue gets more important as the industrialists replace the environmentalists to occupy more in the population. If the tax revenue effect and the environmental benefit effect are almost the same already, this implies that other things being equal, as the industrialists (environmentalists) occupy more (less) in the population, an IEA is less (more) likely to be made, respectively, even without the lobbies' competition.

A more interesting case occurs when lobbies compete with each other with positive contributions. In a country if a lobby wins a regime with a positive contribution, the government representative should be indifferent to the two options of signing or not. Otherwise, the winning lobby with a positive contribution could reduce its contribution a little bit to increase its welfare without affecting the regime the politician would choose. Furthermore, when the lobby on the losing side became aware of this, it must have offered its contribution for its preferred regime with the full amount of what it stands to lose under the regime chosen. Otherwise,

it could increase its investment a little more to sway the politician's decision to its preferred regime. Using these facts, we can show that the negotiated tax rates could be an equilibrium agreement with positive lobby contributions if that tax rates would incur a certain ranged profit losses in both countries. This is specified in the following proposition 2.

Proposition 2

A negotiated tax rate (t_1, t_2) would come under pressure from the environmentalists' lobbies in both countries to be included in an IEA if (1) lobbies' expectations in the two countries are fulfilled in (t_1, t_2) and (2) for each country i , the profit loss incurred is in the range as specified in the following inequality.

$$\begin{aligned} & \left(\frac{a_i + \alpha_i^I}{a_i + 1}\right)(\tau(t_i) - \tau(t_i^N)) + \frac{a_i \alpha_i^E}{(a_i + 1)} (\theta_i \sum_k (X_k(t_k^N) - X_k(t_k))) \leq (\pi_i(t_i^N) - \pi_i(t_i)) \\ & \leq \left(\frac{a_i + \alpha_i^I + \alpha_i^E}{a_i + 1}\right)(\tau(t_i) - \tau(t_i^N)) + \alpha_i^E (\theta_i \sum_k (X_k(t_k^N) - X_k(t_k))) \end{aligned}$$

Proof : As the politician should be indifferent between the two regimes, $\sum_L C^{LA} + aW^{SA} = \sum_L C^{LN} + aW^{SN}$. Also, the industrial lobby, as the loser under A , should invest the full amount of what it stands to lose under A or what it stands to benefit under N , i.e., $C^{IN} = W^{IN} - W^{IA}$. Since the environmental lobby, as the winner under A , would invest no greater than what it stands to benefit, $C^{EA} \leq W^{EA} - W^{EN}$. Also, $C^{IA} = C^{EN} = 0$. Putting all these conditions together, we will get that $(W^{IN} - W^{IA}) + aW^{SN} \leq (W^{EA} - W^{EN}) + aW^{SA}$. Putting in the equation for each term and rearranging, we can get the right hand side inequality in the proposition. For the left hand side inequality, it suffices to note that otherwise, an IEA could be possible even without lobbies' contributions. (refer to Proposition 1) QED.

Proposition 2 deals with the situation where the environmentalists pressure the politician to sign on an IEA to prevent the industrialists from swaying the politician in favor of maintaining the status quo. The environmentalists' lobby should invest a minimal sufficient amount to prevent this. More specifically the environmental lobby's contribution should be its opponent's contribution (C^{IN}) either plus a times the politician's extra benefit under N ($a(W^{SN} - W^{SA})$) or minus a times the politician's extra benefit under A ($a(W^{SA} - W^{SN})$). However, in the process, the sum of all the lobbies' welfare and a times the social welfare is maximized. To see this we can rearrange the inequality $(W^{IN} - W^{IA}) + aW^{SN} \leq (W^{EA} - W^{EN}) + aW^{SA}$ to get the following inequality : $\sum_L W^{LA} + aW^{SA} \geq \sum_L W^{LN} + aW^{SN}$

Propositions 1 and 2 are concerned with the cases where the two countries have similar conditions at the same time. In other words, they deal with the cases when the lobbies do not compete in both countries or when they do compete in both countries. However, there are two more cases when an IEA is possible, i.e., when one of the countries has no lobby competing, while the other country has lobby competition.

On the other hand, a strong industrialists' lobby can push for the IEA not to be signed. However, in contrast to the previous cases, only one country's opposition is needed for breaking down IEA negotiations. If the profit-loss for the industrialists' lobby under an IEA is so strong, the industrial lobby has a strong incentive to sway the politician in favor of maintaining the status quo with a sufficient amount of contribution. More specifically if the profit-loss is greater than the right end of the inequality in Proposition 2, the environmental lobby contributes the full amount of $W^{EA} - W^{EN}$ but fails in inducing a favorable IEA. (Please, refer to the proof of Proposition 2)

As we have seen in Propositions 1 and 2, the important factor for enacting an IEA is the relative size of profits and losses, changes in tax revenue, and environmental damages. However, this relative-size effect does not cross over to the other country. In other words, for an IEA to be accepted, the necessary relative size of a country's domestic factors needs to be assured in both countries. This does not mean that the condition in a country is independent of the condition in the other country. They are interdependent through their mutual expectations of the partner country's tax choices. Once this expectation is changed, the domestic political equilibrium in the country would also change and thereby, so would the possibility of an IEA.

Since the relative size of the profits and losses, tax revenue changes, and environmental damages consists of various parameters, we can use the parameters to do a comparative static experiment. First of all, the price elasticity of supply is critical because the tax rate change due to an IEA changes the price to the producers. This in turn leads to the change in the level of output, the size of which depends on the price elasticity of supply and the initial ratio of tax rate to producer's price. Finally this leads to the change in the profits, tax revenue and environmental damages. Secondly, the emission coefficient θ clearly determines the environmental benefit due to an IEA. As θ goes up, the environmental benefit due to an IEA goes up. Thirdly, the population share is important. The total population share of all lobby groups is important as well as the share of an individual lobby. The reason why the population share is important is that as more people concern the result of an international negotiation, the negotiation itself is more likely to be affected in domestic political process. The value a concerned group of people attach on the negotiation is also important. In other words, the relative size of tax revenue and environmental damages is also important in determining the fate of an international negotiation. Lastly, the effect of a is clear on the range of

an IEA being made with no lobby competition. Recall that a is the weight the politician places on the general welfare. As the politician places a higher weight on the general welfare, the place gets narrower where the industrialists can sway the politician's decision in favor of their interest. The discussions so far in this paragraph are summarized in the following proposition.

Proposition 3

(i) As long as the supply curve at the status quo is not too price-elastic and/or as the emission coefficient gets larger, the range of an IEA being made gets widened. (ii) As the population share of environmentalists gets higher, other things being equal, the possibility of an IEA being made gets higher. However, though the industrialists' share gets higher, other things being equal, the range of an IEA under pressure is not affected but the range of an IEA with no pressure. (iii) The higher the weight the politician places on the general welfare, other things being equal, the wider the range of an IEA being signed on.

Proof: (i) The tax rate elasticity of supply ε_t can be defined as $-\varepsilon_p \cdot (t^N / p^N)$ where ε_p represents the price elasticity. As long as $\varepsilon_t < 1$, with an IEA, the tax revenue would increase and the environmental benefit would also increase. Then, the two ends of the inequality in Proposition 2 would increase with the right end increased more because the coefficients in the right end are bigger than the ones in the left end. Now the condition for $\varepsilon_t < 1$ is that $\varepsilon_p < (p^N / t^N)$. Since the tax rate is usually smaller than the producer's price, this means that the supply curve should not be too price-elastic. The case for θ can be proved in the same manner.

(ii), (iii) Again, refer to the inequality in Proposition 2. As α^E increases, other things being equal, the two ends of the inequality would increase with the right end increased more. Likewise, as α^I increases, other things being equal, the two ends of the inequality would increase by the same amount. In the same manner, as a increases, other things being equal, the two ends of the inequality would increase with the left end increased more. QED

Remember that the lobbies' expectations need to be realized in the negotiated tax rates and consistent with each other under the IEA. However, our model does not fully explain how the expectations are formed. Rather, it just assumes their formation.

For example, suppose the lobbies in the two countries expect the politicians to play a Nash-Bargaining game and their expectations are consistent with each other. Then is the Nash-bargaining solution politically viable? The answer depends on various parameters. One of the key features of Nash-bargaining solution is that it is Pareto efficient and the coordinated tax rate increase is maximal vis-à-vis the status quo. If the tax increase is sufficiently large and damage is convex while production

is concave, then the profit-loss would be severe relative to environmental benefits. In such a situation, the negotiation might be pressurized not to come to an agreement. Thus, a milder tax increase is more likely to be coordinated as an IEA.

Hoel (1991) has indicated that a country's unilateral action with good intentions might well undermine the global welfare because the other country would be induced to take advantage of the first country's good actions. However, from the perspective of our model, a country's unilateral action might change the expectation of the lobbies in the other country and the structure of the interests in that country. This might lead to a new possibility for signing an IEA that otherwise would not have occurred.

IV. Concluding Remarks

In a simple framework of lobby competition for a politically oriented government agency, this paper has provided the conditions under which two small open economies could reach an IEA on the common environment they share. In achieving this, the critical factors are the price elasticity of supply, emission coefficient, population shares and the weight the politicians place on the general welfare.

Existing literature on international environmental problems proposes various mechanisms or solutions for such environmental cooperation and improvement but assumes an unrealistically politically neutral government negotiator. In contrast, this paper assumes a more plausible scenario and provides a framework through which the existing proposals for environmental cooperation can be evaluated with a more realistic view. It could be said that Siqueira (2003) and Buchholz, et. al. (2005) also provides a framework in which domestic politics affects an international environmental negotiation with voters electing their preferred government negotiator. Yet, this paper presents a different scenario in which domestic politics matters in an international environmental negotiation, especially when taking into account lobby competition and a politically oriented government negotiator involved in the negotiations.

At this stage, remarks on the limitation of our simple model are in order. First, negotiations by the government agencies are not analyzed, but a negotiated outcome is assumed and the expectations of the lobbies are assumed to be consistent with each other for an IEA. To overcome this limitation, a formal negotiating process may be introduced into the model in a future study. Second, in our model, one country's action does not directly cross over to the other country. However, a lobby in one country might cooperate with a lobby in the other country, for example. Third, the analysis has been conducted in a two-country framework. However, the more general case is when $n (> 2)$ countries are negotiating for an IEA like Kyoto

protocol or Montreal protocol. In addition, only a partial agreement makes an IEA come into effect. Nevertheless, in light of our simple model, we can imagine that a multi-country IEA could be possible if, given the expectations of all the lobbies in $n (> 2)$ countries, a sufficient minimal number of countries have the conditions described by Propositions 1 or 2.

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