Université Paris1

UFR 02 Sciences Economiques - Master 2 Recherche: Empirical and Theoretical Economics (ETE)

Ability of Greens and Supergreens to Influence Environmental Regulations

Présenté et soutenu par:

Lenka Wildnerova

Dirigé par:

Professor Katheline Schubert

July 5, 2013

L'université de Paris 1 Panthéon Sorbonne n'entend donner aucune approbation, ni désapprobation aux opinions émises dans ce mémoire ; elles doivent être considérées comme propre à leur auteur.

1 Introduction

One of the ways for individuals to influence political decisions is through a lobby group membership. Lobby groups collect the membership fees, and via contributions to the incumbent government, they attempt to impact its policy implementation. This paper aims to model the environmental lobby groups and producer lobbies to determine the outcome on emission levels and environmental policies in a large open economy set-up. We consider two large countries engaged in a free trade agreement, experiencing environmental problems from both, local and transboundary pollution.

Lobbying represents an important part of the political process in some countries. Lobby groups contributed over $2 million to the presidential candidates in the 2012 US elections, while in the 2008 elections, the contributions crossed the $5 million[1]. Although relatively small in size compared to the total raised contributions, the lobby gives a monetary amount to the government with a precise objective to influence policy, and moreover, the green lobbyists and attorneys assist the government officials to create legislation involving environmental protection. Furthermore, the numbers listed above are only the contributions listed as from "lobbyists": much more coming from individual members of different societies, industries, and organizations. These individual political offerings do not classify as lobby contributions by the agency enclosing the information regarding the election donations, but we shall consider them within our model. It is also important to note that the environmental non-governmental organizations, whether international, continental, or local, have grown in numbers and size in the past years. To list only a few examples, there is about sixty official large international environmental non-governmental agencies; for the national green organizations, there are over 110 in the US, around 40 agencies in United Kingdom, three in China, all fighting to protect and conserve the environment locally, involved in environmental management, advocacy, or raising awareness and influencing policies connected to the climate change and other global environmental problems in general. For the most influential international green lobby groups, Greenpeace received €202.5 in 2008 from 2.6 million of contributors around the world. Another possibility to create an alliance to fight global problems is to link multiple national green organizations: the Climate Action Network connects more than 850 non-governmental organizations in 90 countries. For the national environmental lobby groups, the Environmental Defense Fund's revenue in 2011 was $ 98 million,

[1]From www.opensecrets.org

with over 700,000 members[2]. In this paper, we also capture the concept of local lobby groups, fighting local environmental problems. There exist numerous local lobby groups fighting for preserving wilderness, opposing nuclear power and nuclear weapons, or concerned with contamination of ground water or air pollution.

This paper explores the impact of the pressure from the environmental lobby groups on the environmental tax. We study multiple different formations of the lobbies: national green lobby cares about the pollution influencing home environment, local greens lobby exclusively for the lower pollution at home, and finally the supergreens experience the disutility from the transboundary pollution. Additionally, we check the influence of the producer lobby groups, and find that if the pollution is transboundary and spillover effects are large, the national green lobby and supergreens fight for the same environmental policy as the producer lobby. However, the local greens will always fight for strict policies. We rely on the previous research when modeling the lobby influence, especially the work of Grossman and Helpman (1994, 1995), the common agency model of Bernheim and Whinston (1986), and the research on the green lobby problematic described in the following lines.

The lobbying for environmental protection has been explored especially in 1990s and at the beginning of the 2000s. Most of the literature focuses on the interaction between small economies. Persson (2012) looks at the consequences from negotiations between small open economies experiencing environmental problems from transboundary pollution. He finds that if the green lobby groups in one country care about pollution more than the other country does, they are willing to accept more pollution at home as a result of lower than expected tax if the foreign pollution decreases due to the foreign introduction of the pollution tax. The author assumes that the agreement between two governments is reached as it ensures higher welfare for both countries, and the pollution tax depends on the welfare level achieved from bargaining process in both countries. Unlike the earlier literature discussing solely unilateral or cooperative policies, Persson's paper is focused on demonstrating how the environmental tax reacts if the policies are set as a result of negotiated agreement between two governments. Persson does not consider the case when the governments do not engage in a negotiation process and implement the environmental tax unilaterally, which we shall discusses in this paper.

[2]From the websites of the individual lobby groups and the Internet

Other published research in the topic explores the imperfect competition model with international mobility of pollution where environmentalists are relatively concerned with the pollution abroad (see Aidt 2005). The immobile pollution is defined as the pollution which is mostly deposited within the country where it was created, while mobile pollution is deposited in both: the neighboring country and the country of creation. The increase of the environmental tax in the home country while the pollution is mobile will induce lowering pollution in both countries; while with immobile pollution, the green lobby will accept reducing the tax on pollution at home for the lower pollution abroad if the home lobbyists care sufficiently enough about pollution abroad. Aidt (2005) avoids the need of use of the emission leakage issue in order to show the results. The idea of the mobility of pollution is partially applied in our work; however, the reasoning for the results in Aidt (2005) are not compelling and logical as he assumes that the local green lobby cares very highly about local pollution in the foreign country. This problem will be tackled in our work.

In most of the other cases, previous literature on lobbying in small open economies with local pollution indicates that increase in green lobbying leads to higher pollution taxes. For example, Fredriksson (1997b) introduced the tax elasticity of pollution, and found that unless the green lobby group's share of total pollution tax revenue decreases with increasing tax, the effect of green lobbying on the pollution tax is unambiguously positive. In the work of Aidt (1998), the consumer experiences the disutility from pollution, and each industry can organize a producer lobby that campaigns for subsidy and tax levels. Aidt finds that the emissions produced by industry k are greater than the Pigouvian level if this industry is organized, lower otherwise. If all sectors are organized, the government chooses the tax rate replicating the social optimum. In the presence of green lobbying, the tax is greater than the Pigovian adjustment, as both government and green lobby care about the pollution. The work by Fredriksson and Aidt gives insight into different lobby group influence and tax-setting, but does not consider the problem of international agreements, transboundary pollution, or emission leakage. In this work, we consider both green and producer lobby groups, with transboundary and local pollution, and address the question of the rising lobby influence on the emission levels.

One of the very few publications on large open economies with green lobby groups where the author addresses the emission leakage problem is by Conconi (2003), who analyzed the lobby group influence on the environmental tax in different trade regimes for unilateral and centralized decision

making. Conconi's goal is to highlight a need for an international environmental agency, as she proves that when the countries are bounded by free trade agreements and do not coordinate the environmental policy, and moreover if the spillover effects of the pollution and the terms of trade are sufficiently big, then the increase of the proportion of environmentalist in the country will cause a decrease in the pollution tax. The environmental leakage plays an important role in the analyses: the contradictory result arises from the fact that since the tax on goods rises, and as a result the home producer price goes up, then, the production drops. As we are in the large economy set-up, due to the price increase at home, also the international price rises depending on the elasticity of production and imports/exports of both countries. Then, the foreign country, whose producer price remains the same, is able to produce more to satisfy the demand of the home market where the production is smaller due to the higher price. The policy outcomes are evaluated for multiple lobby group cases: national greens who care about pollution at home, international greens, whose objective is to maximize the sum of the utilities of the greens in both countries, and finally national green and producer lobbies that experience disutility from home pollution and care about rents, respectively.

Conconi's research opens up to other research possibilities. Our work relies on Conconi's previous results, and explores the different lobby groups in a free trade scenario, when the country raises the tax unilaterally, and when it achieves an agreement with the other country. We would like to find out what happens to the tax and emissions when the country becomes greener. The addition of this work to the discussion on the topic of environmental lobbying is in modeling the local and global lobby groups, both considering different type of pollution. Moreover, Conconi showed that the tax can be possibly smaller if the number of environmentalists in the country increases, which we show is not true for the local lobby group. Additionally, Conconi did not follow the analyses further to show the influence of this change on the emissions and the importance of the aggregate social welfare, which are addressed in this paper.

We describe the model in the next section, and list the results of environmental lobbying on the policy that the government implements in the section 3. We look at the unilateral choice of policies, and check the influence of individual lobby groups when they act by themselves, and then we verify the tax level for the case when the greens lobby together with the producers. Additionally, we check the case for the cooperative policies, change of the weight of the aggregate social welfare, and explore the role of assymetries. The section 4 concludes.

2 Model

Let us consider a global economy with two large countries, home and foreign, the later denoted by a star (*). The countries are bounded by a free trade agreement and are negatively influenced by the emission from its own as well as foreign production process. We assume the absence of international environmental regulatory agency.

2.1 Production

Each country produces $N+1$ goods, $i = 0, 1, ..., N$ where the good $i = 0$ is the non-polluting numeraire produced using linear technology with labor as the only input, and traded freely on the international markets. Each good i is produced by exactly one industry, which keeps the same subscript. The production of the rest of the goods requires labor and sector specific input; the goods are produced with constant returns to scale technology. All goods are tradable on the international markets. The price of the numeraire good is chosen to be equal to 1 on both home and foreign markets, and the wage is also normalized to 1 in both countries. The domestic price for non-numeraire goods the consumer pays is $q = (p_1^W, ..., p_n^W)$, which is also the world market price, while producer price is $p = (p_1, ..., p_n) = (p_1^W - t_1, ..., p_n^W - t_n)$ where t_i is the tax imposed by the government on the industries producing polluting goods and p_i^W is, as mentioned earlier, the price for good i on the international market. Then, the tax revenue from the pollution tax is given by the sum of the tax collected from taxing each good. $\sum_{i=1}^{N} t_i x_i$ and is redistributed uniformly to all individuals in the country.

In the production sector of the economy, the firms are earning a rent $R_i(p_i)$ from producing the good i. The supply function of the industry is defined from the Hotelling's lemma as $Y_i(p_i) = \frac{\partial R_i}{\partial p_i}$. Production process in each of the sectors $i = 1, ..., N$ generates emissions $E_i = \alpha_i Y_i$ where α_i is an exogenously given sector specific coefficient measuring the amount of the pollution associated with the production of good i. The emissions can damage local environment or they might cause global environmental problems.

The $\theta_i E_i$ is the part of emissions from the production at home that damages the local environment, while $(1 - \theta_i)E_i$ is the transboundary pollution. Here, θ_i is a coefficient between zero and one, standing for how much of the emissions produced by the industry i is local, while the rest of

emissions create transboundary environmental problems; if pollution is strictly local, then the second term of the equation (1) vanishes, and for perfectly transboundary pollution, $\theta_i = 0$. Similarly, for the foreign country, the emissions damaging their local environment are $\theta_i^* E_i^*$ and the transboundary pollution produced abroad is represented by $(1-\theta_i^*)E_i^*$. Then, the function of total emission in the country is a sum of all emissions produced by home industries and only global emissions produced abroad:

$$Z = \sum_{i=1}^{N} \theta_i E_i(p_i) + (1-\theta_i)\left(E_i(p_i) + E_i^*(p_i^*)\right) \tag{1}$$

Here, we assumed for simplicity that the emissions produced by the industry i are influencing local environment and producing the transboundary pollution the same way as the industry i in the foreign country, i.e. $\theta_i = \theta_i^*$. It is now possible to see that function of the global environmental problems is a sum of the transboundary pollution produced at home and abroad, while local problems are a burden only for the country which produces them.

2.2 Consumption

On the consumer side of our model, we normalize the population in the home country to one. Each individual enjoys utility from consumption and experiences disutility from pollution damaging home environment; their preferences are quasilinear and additively separable. The utility function for the representative agent is independent of the membership in the lobby group and is represented as follows:

$$u_h(c_0, c_1, ..., c_N, Z) = c_0 + \sum_{i=1}^{N} u_i(c_i) - Z \tag{2}$$

where c_0 is the consumption of the numeraire good and c_i is the consumption of the non-numeraire goods. The utility function $u(c)$ is twice differentiable, increasing, and strictly concave.

The consumers pay the price p_i^W, which is the price for good i on the international market, while the producers pay the tax as the producer price is given by $p_i = p_i^W - t_i$. Then, the demand for good i is a function of price: $D_i(p_i^W)$, and the imports (or exports if M_i is negative) are simply given by $M_i(p_i^W, p_i) = D_i(p_i^W) - Y_i(p_i)$. It is possible to derive the world equilibrium prices as a function of the tax policies in both countries: $p_i^W(t_i, t_i^*)$ as in the equilibrium, the world markets clear and $M_i + M_i^* = 0$. Note we do not consider any trade costs.

2.3 Emission Leakage

The emission leakage problematic arises when a country introduces stricter environmental policy than the foreign country, which increases its production, and therefore emissions. In this section, we use the results of Conconi's analyses, who found that the change of the price when we increase the tax can be expressed by the equation:

$$\frac{\partial p_i^W}{\partial t_i} \equiv \delta_i = \frac{\epsilon_i^Y}{m_i \left[\epsilon_i^M - \epsilon_i^{M^*}(p_i/p_i^*)\right]} \tag{3}$$

This relation is the ratio between price elasticity of domestic supply and import elasticity multiplied by the import-to-GDP share $m_i \equiv \frac{M_i}{Y_i}$. The price elasticity of domestic supply is defined by $\epsilon_i^Y \equiv -\frac{\partial Y_i}{\partial p_i}\frac{p_i}{Y_i}$, and the price elasticity of import demand (or export supply if M_i is negative) are defined by $\epsilon_i^M \equiv \frac{\partial M_i}{\partial p_i}\frac{p_i}{M_i}$, with M^* and p_i^* for ϵ_i^{*M}. This increase δ_i is always between 0 and 1.

The unilateral increase of the domestic tax on production of the good i will have a negative impact on the emissions produced at home, and a positive influence on the production abroad, and therefore also emissions, as the comparative advantage shifts towards foreign country. The emissions produced by the domestic industries will unambiguously decrease:

$$\frac{\partial E_i}{\partial t_i} = (\delta_i - 1)\,\alpha_i \frac{\partial Y_i}{\partial p_i}$$

while the foreign emissions will increase:

$$\frac{\partial E_i^*}{\partial t_i} = \delta_i \alpha_i^* \frac{\partial Y_i^*}{\partial p_i^*}$$

Then, we have that the pollution at home changes with the change of tax:

$$\frac{\partial Z}{\partial t} = (\delta - 1)\,\alpha \frac{\partial Y}{\partial p} + (1-\theta)\delta\alpha^* \frac{\partial Y^*}{\partial p^*} \tag{4}$$

The equation (4) consists of two terms. The first represents the direct effect of the tax increase, which produces the domestic emission reduction, and the second term is the indirect effect of the unilateral tax policy, and causes the transboundary foreign emissions to rise. The pollution in the home country will increase despite an increase in the pollution tax if the indirect effect is bigger

than the direct effect. Taking symmetric countries, the emission leakage takes place if $\delta(2-\theta) > 1$.

Recent research on the topic of environmental taxation has shown that the government will adopt lower than the optimal tax if the pollution is transboundary, while for the local pollution, the implemented tax control is at its maximum level, as analyzed by Anoulies (2012). Anoulies showed that as the local pollution is taxed fully, the firms have an incentive to relocate their production to environmentally lax countries, while the cost of transboundary pollution is born by multiple countries therefore, the tax is lower. Other literature (see Barrett 1998) also proves that the taxes introduced by the welfare-maximizing government on the production creating transboundary pollution are lower that it is optimal; moreover, in the presence of environmental leakage, the equilibrium tax will be even lower. Considering these results, we would like to check if the presence of the green lobby groups influences the tax level in the opposite way and if we can recover the tax level equal to the Pigouvian tax that would be present if there were no lobbies present. Our expectation is that the green lobby will fight for higher taxes, which could mean that the pollution in the home country increases in the presence of emission leakage as described above.

2.4 Lobby Groups

We consider three different formations of the lobby groups. We assume that some of the individuals in the economy are affected by the pollution more than others, and they join a green lobby. The producers have an incentives to form a lobby on their own. Moreover, we assume that all the individuals who are affected by the pollution more than the rest of the society overcome the free-rider problem. First, the national green lobby group cares about pollution at home and maximizes only its own welfare function; in the second case, the local greens care about local pollution damage while global greens (supergreens) care about the transboundary pollution produced by both countries, maximizing the welfare of supergreen lobby group, who exercise the pressure on its own government in the unilateral policy set-up. Lastly, a producer lobby group is added to the second case, and it cares about maximizing the rents from the production of the polluting good.

Case 1: The welfare of the national green lobby group (NG) is

$$W^{NG}(t,t^*) = A - a^{NG}Z(t,t^*) - \sum_j C_j(t,t^*) \tag{5}$$

where A is a constant, a^{NG} is the proportion of the national greens in the population, and $\sum_j C_j(t, t^*)$ is the sum of the contributions of the members of the green lobby group, $j \in NG$. The function $Z(t, t^*)$ is the same as it was defined in (1).

Case 2: The welfare of the local greens group that care only about local pollution is

$$W^{LG}(t) = A_1 - a^{LG}\theta E(t) - \sum_j C_j(t) \quad j \in LG \tag{6}$$

with $\theta E(t)$ being the pollution influencing only the local environment.

The welfare of the supergreens is

$$W^{GG}(t, t^*) = A_2 - a^{GG} Z_G(t, t^*) - \sum_j C_j(t, t^*) \quad j \in GG \tag{7}$$

where $Z_G(t, t^*) = \sum_{i=1}^{N} (1 - \theta_i) \left(E_i(p_i) + E_i^*(p_i^*)\right)$. Here, A_1, A_2 are constants and a^{LG}, a^{GG} are the proportions of the population organized into the particular lobby group. Note that here, the local greens do not have the same objective function as the national greens in the case 1. The local greens care exclusively about the local environmental problems, while national experience disutility from all the pollution affecting their country. Supergreens, on the other hand, cannot consider particular environmental problems, and only the transboundary pollution enters their welfare function. In the previous research, the international green lobby groups considered the total pollution in both countries (see Conconi 2003).

Lastly, the third case includes the producer lobby groups. Assuming that the members of these groups are the owners of the production factors, they care about the rents they earn from production of the good that requires this particular factor. The members pay the contributions to their lobby group. Not all owners of the factors are necessarily organized. The fraction of the factor owners that is organized is denoted by L. Then, we can define the welfare of the individual producer lobby group owning the factor i, with a_i^P being the proportion of the population comprised of the members of the production sector i, as follows:

$$W^P(t, t^*) = a_i^P R_i(p_i) - C_i(t_i, t_i^*) \quad i \in L \tag{8}$$

We assume that the contribution schedules of all lobby groups maximize their welfare function and are feasible. The contributions cannot be negative, but can be zero if the lobby group believes its contribution will not affect or sustain the policy. The funding for the contributions comes from the individual income, and reflects in the government welfare function as explained in the next section.

2.5 Government

To solve the maximization problem of the government, which will determine the optimal tax, we set-up the objective function that follows the Helpman and Grossman (1994, 1995) equilibrium representation. The incumbent government's ultimate goal is to get reelected, and for this reason, it cares about the contributions and the welfare of the consumers. The government welfare can be then represented as follows:

$$G(t, t^*) = \omega W(t, t^*) + \sum_k C_k(t, t^*) \tag{9}$$

where k represents the lobby group: $k = \{NG\}$ in case 1, $k = \{LG\}$ and $k = \{GG\}$ in case 2, and finally, $k = \{LG, GG, P\}$ for the third case. The weight the government places on the aggregate domestic welfare is denoted by ω. The domestic welfare is the sum of aggregate income, tax revenue, total rent, and total consumer surplus minus the environmental damage:

$$W(t, t^*) \equiv l + \sum_i^N t_i Y_i(p_i, p_i^*) + \sum_i^N R_i(p_i) + \left[\sum_i^N u_i(D_i(p_i^W)) - \sum_i^N q_i D_i(p_i^W) \right] - Z(t, t^*) \tag{10}$$

As mentioned in the lobby group section, the contribution schedule comes from the income I, and therefore reflects in the domestic welfare. We write:

$$G(t, t^*) = \mu_1 \left[W(t, t^*) - \sum_k C_k(t, t^*) \right] + \mu_2 \sum_k C_k(t, t^*)$$

which is the same as setting $\omega = \frac{\mu_1}{\mu_2 - \mu_1}$ and maximizing the function (9). To set the tax on pollution, the governments engage in a political talk as described in the next section.

2.6 Political Game

The governments can cooperate, i.e select the same policies as the supranational organization would through maximization of the weighted sum of the national welfares. Otherwise, the governments remain in the uncooperative equilibrium, and implement their policies unilaterally. As in Grossman and Helpman (1994, 1995), the political process is modeled as a two stage game. In the first stage, the lobby groups offer their campaign contribution schedule to the government, taking the contributions of the other lobby groups as given, acting simultaneously and non-cooperatively. The lobby group is assumed to fulfill its promises and pay the amount of the contributions in the second stage. The government, facing various lobby group contributions, chooses a vector of taxes by maximizing its own welfare (9). In the second stage, the governments choose their environmental policies, unilaterally or cooperatively. The non-cooperative game's solution between two governments is given by a subgame perfect equilibrium.

From the maximization of the joint welfare of each lobby and the government, and the utility maximization of the government, we get that with the small change in policy, the change of the amount of the contributions is the same as the effect of the change on the lobby's gross welfare: $\frac{\partial C_k(t)}{\partial t} = \frac{\partial W_k(t,t^*)}{\partial t}$. Grossman and Helpman (1994, 1995) and Bernheim and Whinston (1986) call this property "local truthfulness", and it corresponds to the marginal willingness to pay for a change in the tax policy. The derivation of this property is Grossman and Helpman (1994). Dixit (1996), and Fredriksson (1997(b)). We proceed with computation of the optimal tax for each of our cases of the lobby groups, in a cooperative and unilateral decision process, and check the change in emissions produced, and see the influence of the increase of the green lobby membership on the results.

3 Environmental Policy in the Presence of Green Lobbying

The main goal of this paper is to show how the presence of different lobby groups influences the environmental policy in a free-trade policy regime. Due to the possible effect of the emission leakage, the environmental degradation can increase even if the tax on pollution rises. We would like to check if this result is balanced out when the green lobby groups are present. To do so, we use the exogenous change in proportion of the lobby group members in the country's population.

3.1 Unilateral Policy Choice

First, we focus on the situation when the environmental tax is introduced by the home country only. To start, the countries are assumed to be symmetric. The asymmetry is discussed later in this work. The derivation of the equilibrium tax is explained in detail in the appendix.

3.1.1 Case 1: National Lobby Group

Suppose there exist only one lobby group which cares about the pollution affecting the home country. The government then sets the optimal tax in the home country equal to:

$$t = \frac{\alpha\left(\omega + a^{NG}\right)(2\delta - \theta\delta - 1)}{\omega\left(\delta - 1\right)}$$

If the proportion of environmentalists a^{NG} in the home country increases, it will have an ambiguous effect on the tax as

$$\frac{\partial t}{\partial a^{NG}} = \frac{\alpha(2\delta - \delta\theta - 1)}{\omega(\delta - 1)}$$

is negative if $\delta(2-\theta) > 1$, and therefore has an opposite effect as expected. The condition is therefore fulfilled if the "transboundarity" of the pollution is large, so θ close to zero, and the spillover effects δ are big enough. For perfectly transboundary pollution, it is sufficient that the effect on the international price is $\delta > 1/2$ in order for the tax to fall with the increase of the environmentalists.

The lobby group cares about the emissions, as the total pollution at home will influence its utility function. The condition for the emissions to increase even if higher tax is introduced in the equation (4) is $\delta(2 - \theta) > 1$, which coincides with the condition when this environmental group lobbies for lower taxes. Therefore, in the presence of emission leakage where the pollution in the home country increases due to the high emission of the transboundary pollutants by the foreign country, the increase in the national green lobby group membership will push the tax down if there is the risk of the foreign country polluting the home environment. The national green lobby ensures that the pollution in the home country does not increase. This result is coherent with the rationality of the lobby group.

3.1.2 Case 2: Local Greens and Supergreens

Now we consider two green lobby groups: local greens whose objective is to impose a tax on locally polluting industries, and supergreens, with the objective of the government tackling the transboundary pollution. First, we determine the optimal tax if these lobbies act alone in the home country; in the case 3, we explore the situation if they act together.

The pressure from the local greens will result in the implementation of the following tax:

$$t = \frac{a^{LG}\alpha\theta}{\omega} + \frac{\alpha\left(2\delta - \theta\delta - 1\right)}{\delta - 1}$$

which changes when the lobby proportion increases, and will result in unambiguously higher taxes:

$$\frac{\partial t}{\partial a^{LG}} = \frac{\theta\alpha}{\omega}$$

The increase in tax on the locally polluting good will increase the international price by the amount δ, and decrease the production at home. On the other hand, the pollution in the foreign country, due to increase of production, rises. As $\delta \in (0, 1)$, the pollution in the foreign country rises by smaller amount than it fell in the home country. From the equation (4) it is evident that as the pollution is local, so θ is close to 1; therefore, the rise in foreign pollution influences the home consumers less than the fall in domestic pollution amount. The global level of pollution falls as well.

If the government receives the contributions only from the supergreens, the maximization of its objective function results in obtaining the tax rate:

$$t = \frac{a^{GG}\alpha(2\delta + \theta - 2\theta\delta - 1)}{\omega(\delta - 1)} + \frac{\alpha(2\delta - \theta\delta - 1)}{\delta - 1}$$

And with the change in the number of supergreens will have an ambiguous impact on the environmental policy:

$$\frac{\partial t}{\partial a^{GG}} = \frac{\alpha(2\delta - 2\theta\delta + \theta - 1)}{\omega(\delta - 1)}$$

In this case, the tax on the polluting good will be lower despite of the increase of proportion of supergreens if $2\delta(1 - \theta) + \theta > 1$. This means that if the pollution is transboundary, and the spillover effects are large, then the supergreens will achieve that the government implements lower

taxes. The sufficient condition for this to be valid is that spillover effects are $\delta > \frac{1}{2}$ for any level of transboundarity of the pollution θ. With respect to the emissions damaging the home environment, if the condition for the lowering the pollution tax with the increase of the supergreens is satisfied, then also the condition for the emission leakage is satisfied (as $\delta(2-\theta) > 1 \Rightarrow 2\delta(1-\theta)+\theta > 1)$) , so the increase in the efforts of the environmentalists will decrease the emissions despite of lowering the environmental tax.

These results show that the tax falls only if the home consumers would be influenced negatively otherwise. However, for the case with the supergreen lobby present, it might be optimal to support lower tax on the home production of transboundary pollution in some cases. On the other hand, the local environmentalist will always support higher tax on pollution.

If both green lobby groups pay their contributions to the government at the same time, then the increase in the membership numbers of one lobby group will result in a change of tax described above. The situation when the proportion of both local greens and supergreens changes is described in the case 3.

3.1.3 Case 3: Production and Green Lobbies

Let us now consider that we have two types of environmental lobby groups: local greens and supergreens, and the producer lobby groups. We assume as in Fredriksson (1997b) and Aidt (1998, 2005), in contrast with Grossman and Helpman (1994, 1995) that the lobby groups are functionally specialized. This means that the lobby's goal is to affect one particular issue instead of having multiple goals, which is what is observed empirically (Marshall 1998). Both green lobby groups can use their effort to tax different industries i depending on the type (local or transboundary) of pollution each production process emits. The producer lobby group wants the tax to be lower. In Fredriksson (1997a), the producer lobby advocates subsidy for the polluting industry; however, we will follow the examples of Grossman and Helpman (1994), Fredriksson (1997b), Conconi (2003) or others, where both green and the production lobby offer contribution to the incumbent government. On one hand, the lobby groups attempt to influence the environmental policy implemented by the government, but as the lobbies take the contributions of the other lobby as given, not contributing would also mean that the policy will be shifted in favor of the contributing lobby.

For a simple representation and interpretation, we consider only two goods $i = \{1, 2\}$ whose by-

product in the production process is local or global pollution: for $i = 1$, $\theta = 1$, so good 1 is a local pollutant, and for $i = 2$, $\theta = 0$, and therefore, production of good 2 causes purely transboundary pollution. We assume that the change of the tax on each of the good results in the same change on its international price $\delta_1 = \delta_1 = \delta$. We continue with the assumption of symmetric countries, so we have $\frac{\partial Y}{\partial p} = \frac{\partial Y^*}{\partial p^*}$ and $\alpha_i = \alpha_i^*$. On the producer side, two lobby groups can be formed advocating a lower tax on the good they produce. The detailed derivation of the equilibrium tax is precised in the appendix. The tax on the good 1, the local pollutant will be the following:

$$t_1 = \frac{\alpha_1(a^{LG} + \omega)}{\omega} - \frac{a_1^P Y_1}{\omega \frac{\partial Y_1}{\partial p_1}}$$

Notice that only the local lobby influence enters the decision of the government about the tax on locally polluting good. The local pollution influences the local greens and all the consumers. The impact of the production lobby is negative, as the the producers aim to lower the taxes, and the weight of their influence depends on the size of their lobby compared to weight the government attaches to social welfare and the supply of good 1 Y_1.

The tax on the transboundary polluting good will be set to:

$$t_2 = \frac{\alpha_2(a^{GG} + \omega)(2\delta - 1)}{\omega(\delta - 1)} - \frac{a_2^P Y_2}{\omega \frac{\partial Y_2}{\partial p_2}}$$

The producers of good 2 and supergreens will fight for the decrease of the pollution tax if $\delta > 1/2$, that is when the spillover effects are large. In this case, both lobbies will achieve lower levels of emissions than if the tax rose.

It is now simple to compare the optimal tax in the presence of lobbies with the Pigouvian levels. Consider that we do not have any lobby groups, i.e $a^k = 0$ for $k = \{LG, GG, P\}$. Then, the optimal tax would be just $t_1 = \alpha_1$ and $t_2 = \frac{\alpha_2(2\delta-1)}{\delta-1} = \alpha_2 + \alpha_2 \frac{\delta}{\delta-1}$. In the case of local pollution, it is optimal for the government to tax all production at the level it emits the pollutant. In the case of transboundary pollution, the tax depends on the size of ratio $\frac{\delta}{\delta-1}$. It is straightforward to verify that the optimal tax can become a subsidy if the spillover effects are above the $1/2$ level (i.e $\delta > 1/2$).

3.2 Coordinated Policies

If the governments decide to coordinate their policies, they will set their environmental tax by maximizing the weighted sum of the governments' welfare (equation (9)) (Grossman and Helpman (1995)):

$$\omega^* G + \omega G^* = \omega^* \sum_j C_j(t) + \omega \sum_j C_j^*(t) + \omega^* \omega \left[W(t, t^*) + W^*(t, t^*) \right] \qquad j \in \{NG, LG, GG\} \quad (11)$$

In the coordinating equilibrium, the countries set the same tax on their markets. Keeping the symmetry assumption, this implies that the imports (exports) do not change; therefore, the countries do not experience any change in the emission leakage. Then, the change of emissions depends simply on the change in production, which is described in the appendix.

The same applies for the foreign country: the consumers benefit from lowering the emissions at home and from the lower foreign transboundary emissions. Again, we differentiate between three cases with different lobby groups. For most of the results, it is necessary to assume symmetry of the countries. The influence of the asymmetry is discussed in the next section.

3.2.1 Case 1: National Green Lobby

From maximizing (11), we get that the national environmental group will lobby for the tax

$$t = \frac{2\alpha(2-\theta)(a^{NG} + \omega)}{\omega}$$

which is higher than the tax equilibrium tax with no lobby groups. In this case, the total emissions will be unambiguously lower in both countries.

3.2.2 Case 2: Local Greens and Supergreens

If the policies in the case of local greens are adapted unilaterally, the pollution tax will be:

$$t = \frac{\alpha(2-\theta)(\theta a^{LG} + \omega)}{\omega}$$

The tax on the pollution will always increase. Compared to unilateral case, the tax increases in both countries, and therefore, it lowers the pollution levels in both countries, and the world emissions fall.

In the case of supergreens, the coordinating governments will set the tax:

$$\frac{6(a^{GG}+\omega)(1-\theta)\alpha}{\omega}+2\alpha$$

Also in this case, the cooperation results in lower pollution levels on the global level. The tax will be unambiguously higher if the proportion of greens increases. The drop of transboundary emissions enters the weighted welfare function six times: first, such change affects positively the welfare of the consumer at home and abroad. Then, the welfare of the home lobby increases as the transboundary pollution falls both from lowering emissions at home and abroad. Symmetrically, the foreign supergreens are influenced the same way.

The cooperative policies are therefore unambiguously better for the global levels of emissions for all formations of the lobby groups. If we also consider the producer lobby, it will have a negative influence on the tax as described in 3.1.3.

3.3 Change of the Weight of the Social Welfare

In addition to changing the proportion of the environmentalists in the country, it is interesting to also look at the case when the government increases the weight, ω, it places on the social welfare. First notice that the change in the tax level will not be always the same for all cases of the lobby groups as the change will depend on the relative weight of the social welfare with respect to the amount of the environmentalists. We find that in the presence of National Lobby, Local Lobby and Supergreens, the tax changes in the following way:

National Lobby:

$$\frac{\partial t}{\partial \omega}=-\frac{\alpha a^{NG}(2\delta-\omega\delta-1)}{\omega^2(\delta-1)}$$

Local Greens:

$$\frac{\partial t}{\partial \omega}=-\frac{a^{LG}\alpha\theta}{\omega^2}$$

Supergreens:

$$\frac{\partial t}{\partial \omega}=-\frac{a^{GG}\alpha(\delta+\theta-\theta\delta-1)}{\omega^2(\delta-1)}$$

Notice that the equation representing the change of the tax is similar to the change in the section 3.1 where we explored the increased proportion of the environmentalist: it differs only by a multiple of $-\frac{a^k}{\omega}$ where $k \in \{NG, LG, GG\}$. Therefore, if the government starts caring more about the aggregate social welfare, the influence on the tax is the opposite of what the environmentalist would have had, and the weight of such discount is given by the relative size of the environmentalist groups with respect to the weight on the social welfare. Such result might not be what we would first expect: the average consumers suffers from the pollution damage; however, the government does not increase the tax with the increase of its concerns regarding the social welfare. Rather, it acts against the wish of the environmentalists. We get similar results for the case with the producer lobby: the government will implement an opposite policy of what the producers would lobby for. In the last section that follows, we explore the asymmetries of the countries.

3.4 Asymmetry of the Countries

Up to now, we assumed symmetric economies in some parameters. However, asymmetry can be the decisive element in the discussion about the tax policies. Therefore, it is necessary to explore the situations in which the parameters differ. Once more, we differentiate between the unilateral and coordinated policies.

For all previous results, we assumed symmetry in the size of countries, pollution emitted per unit of output and the change of output with respect to change in price, i.e $\alpha = \alpha^*$ and $\frac{\partial Y}{\partial p} = \frac{\partial Y^*}{\partial p^*}$. To check how asymmetry will influence the tax, we proceed with setting the above parameters for the foreign country being a multiple of the parameters in the home country(β). The computation and results are reported in the appendix, part 2. We find that the pollution tax will be higher than in the symmetric case only if $\beta > 1$ and under the condition that it increases with the higher influence of environmentalists. Moreover, we calculate that in the case when we have only the local green lobby, the size of the country or the pollution it emits per unit of output will imply higher tax with the increase of their influence for $\beta > 1$. For the asymmetry in the price responses of the domestic and foreign supply, we can proceed the same way: if the production shifts more rapidly with the change in the producer price at a given point, then the tax applied in the home country will differ from the symmetric case by a multiple of the relative difference of the effects. More details about the influence on these parameters are in the appendix.

In the coordinated policy choice, besides the symmetry assumption for the size of the country, α and $\frac{\partial Y}{\partial p}$, we also assume the same amount of environmentalists in both countries as well as the weight attached to aggregate social welfare, i.e $a^k = a^{k*}$ and $\omega = \omega^*$. Here, we can proceed in a similar way as with the previous calculations, and find that the small difference in a^k and a^{k*}, and ω and ω^* will influence the policies similarly as the differences in size of the countries. A substantial asymmetry in one of these parameters can imply that the governments fail to cooperate and set their policies unilaterally.

4 Conclusion

The goal of this paper was to explore the environmental policies introduced by the government that cares about the welfare of its citizens and the contributions from the lobby groups. Our addition to the topic of environmental lobbying is in modeling lobby groups, which distinguish between local and global pollution. We showed that in some cases, the environmental lobbying might have a negative impact on the tax level, which is not true for the local lobbying. We questioned if the supergreen lobby can balance out the effects of the country implementing lower tax on transboundary pollution than it is optimal, and we found that it will not be true for cases when the government implements the tax unilateraly, the pollution is mostly transboundary, and spillover effects are large: supergreens will fight for lower tax. Our results for the cooperative policies show that the introduced tax will imply lower global emissions. Moreover, we showed that if the government increases the weight it attaches to the social welfare, it will not increase the environmental tax even if the average consumer suffers from the pollution damage, rather, it will act contra-lobby. We demonstrated that the asymmetries in some parameters will reinforce the tax levels in the case of national lobby and supergreens if the asymmetry parameter in the foreign country is larger.

Bibliography

Aidt, Toke S. "Cooperative Lobbying and Endogenous Trade Policy." Public Choice 93, no. 3/4 (1997): 455-75.

Aidt, Toke S. "Political Internalization of Economic Externalities and Environmental Policy." Journal of Public Economics 69 (1998): 1-17.

Aidt, Toke S. "The Rise of Environmentalism, Pollution Taxes and Intra-Industry Trade." Economics of Governance 6 (2005): 1-12.

Anoulies, L. "Trade and Environment: Policy Responses." Doctorate Thesis. Sciences Po, 2012.

Barret, S. "Political economy of the Kyoto Protocol." Oxford Review of Economic Studies (1998): 14, 20–39.

Bernheim, B. Douglas, and Whinston, Michael D. "Common Agency." Econometrica 54, no. 4 (1986): 923-42.

Conconi, Paula. "Green Lobbies and Transboundary Pollution in Large Open Economies." Journal of International Economics 59 (2003): 399-422.

Dixit, A. "Special-interest lobbying and endogenous commodity taxation." Eastern Economic Journal 22 (1996): 375–388.

Fredriksson, Per G. . "Environmental Policy Choice: Pollution Abatement Subsities." Resource and Energy Economics 20 (1997a): 51-64.

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

Grossman, G. M., Helpman, E. "Protection for Sale." The American Economic Review 84, no. 4 (1994): 833-850.

Grossman, G. M., Helpman, E. "Trade Wars and Trade Talks." Journal of Political Economy 103, no. 4 (1995): 675-709.

Hillman, Arye L., and Ursprung, Heinrich W. "Domestic Politics, Foreign Interests, and International Trade Policy " The American Economic Review 78, no. 4 (1988): 17.

Marshall, L. "Economic instruments and the business use of energy." HM Treasury, UK, 1998.

Persson, Lars. "Environmental Policy and Lobbying in a Small Open Economies." Resource and Energy Economics 34 (2012): 24-35.

Appendix

Part 1: Derivation of Optimal Tax

To find the environmental policy the government implements in the presence of the lobby groups, we maximize the government welfare function, equation (9). We distinguish between unilateral policy choice and cooperation between two governments.

Unilateral Policies

The maximization of (9) yields:

$$\omega \frac{\partial W}{\partial t} + \frac{\partial W^k}{\partial t} = 0 \qquad k \in \{NG, LG, GG, P\} \tag{12}$$

as we know that change of contributions with the small change in the tax at the equilibrium point is exactly equal to change of the lobby's welfare with the change in tax as explained in the section 2.6.

Let's recall the aggregate social welfare:

$$W(t, t^*) \equiv l + \sum_i^N t_i Y_i(p_i, p_i^*) + \sum_i^N R_i(p_i) + \left[\sum_i^N u_i(D_i(p_i^W)) - \sum_i^N q_i D_i(p_i^W) \right] - Z(t, t^*)$$

The change of the social welfare with the change in tax will keep the same form for all derivations in this appendix:

$$\frac{\partial W}{\partial t} = \omega \left[\frac{\partial (tY)}{\partial t} + \frac{\partial R}{\partial t} - \frac{\partial q}{\partial t} D - q \frac{\partial D}{\partial t} - \frac{\partial Z}{\partial t} \right]$$

which yields after substituting for the derivatives:

$$\frac{\partial W}{\partial t} = \omega \left[Y(\delta - 1) + t \frac{\partial Y}{\partial p}(\delta - 1) + Y - D\delta - q \frac{\partial D}{\partial t} - \left((\delta - 1)\alpha \frac{\partial Y}{\partial p} + (1 - \theta)\delta \alpha^* \frac{\partial Y^*}{\partial p^*} \right) \right] \tag{13}$$

Simplifying the above expression, we get the following expression:

$$\frac{\partial W}{\partial t} = \omega \left[t \frac{\partial Y}{\partial p}(\delta - 1) + \delta(Y - D) - q \frac{\partial D}{\partial t} - \left((\delta - 1)\alpha \frac{\partial Y}{\partial p} + (1 - \theta)\delta \alpha^* \frac{\partial Y^*}{\partial p^*} \right) \right]$$

For the individual lobby groups, the change of their welfare is following:

1. National Green Lobby:

$$\frac{\partial W^{NG}}{\partial t} = -a^{NG}\left((\delta-1)\alpha\frac{\partial Y}{\partial p} + (1-\theta)\delta\alpha^*\frac{\partial Y^*}{\partial p^*}\right) \tag{14}$$

2. Local Green Lobby:

$$\frac{\partial W^{LG}}{\partial t} = -a^{LG}\theta(\delta-1)\alpha\frac{\partial Y}{\partial p} \tag{15}$$

3. Supergreens:

$$\frac{\partial W^{GG}}{\partial t} = -a^{GG}(1-\theta)\left((\delta-1)\alpha\frac{\partial Y}{\partial p} + \delta\alpha^*\frac{\partial Y^*}{\partial p^*}\right) \tag{16}$$

Assuming symmetry of the countries (i.e $\alpha = \alpha^*$ and $\frac{\partial Y}{\partial p} = \frac{\partial Y^*}{\partial p^*}$), and simplifying the equation (12), we get the optimal tax in the Section 3.1.

Coordinated Policies

We assume symmetry in the following parameters and derivatives: α, ω, a^k, $\dfrac{\partial Y}{\partial p}$, and the size of the countries. Although this assumption is rather strong, it permits to explore asymmetries in these parameters. Having identical countries in these parameters, however, does not imply that we can find the optimal tax for one country and assume it is the same for the other; rather, we must keep in mind the transboundary emissions that will affect both countries.

When the governments cooperate, they will both implement the tax t on their polluting sectors. Therefore, everything else kept equal, the fact that producer price falls in both countries by the same amount t will imply that in both countries, the production drops and there is no change in imports and exports. We have that the change of emissions at home and abroad is simply:

$$\frac{\partial E}{\partial t} = \alpha\frac{\partial Y}{\partial p} + (1-\theta)\alpha\frac{\partial Y}{\partial p} \tag{17}$$

and

$$\frac{\partial E^*}{\partial t^*} = \alpha^*\frac{\partial Y^*}{\partial p^*} + (1-\theta)\alpha^*\frac{\partial Y^*}{\partial p^*}$$

which is, following our assumptions, the same as (17). Then, substituting into (11), we get 1. National greens

$$2a^{NG}\omega\left[2\alpha\frac{\partial Y}{\partial p} + 2(1-\theta)\alpha\frac{\partial Y}{\partial p}\right] = 2\omega^2\frac{\partial W}{\partial t}$$

which yields the tax as given in 3.2.1. Similarly, for the local greens, the maximization of (11) gives:

$$2a^{LG}\theta\alpha\frac{\partial Y}{\partial p} = 2\omega^2\frac{\partial W}{\partial t}$$

Finally, in the presence of the supergreens, we get

$$2a^{GG}\left[2(1-\theta)\alpha\frac{\partial Y}{\partial p}\right] = 2\omega^2\frac{\partial W}{\partial t}$$

By simplifying these equations, we get the same results as given in the section 3.2.2.

Part 2: Asymmetry Tax

We suppose asymmetry in emission per unit of output α, and/or the size of the country. As we set $\alpha^* = \beta\alpha$, where β is a positive coefficient (if we assume that the foreign country is bigger and pollutes more per unit of output, β is simply a product of these coefficients). Then, the total pollution in the home country is as follows:

$$\frac{\partial E}{\partial t} = \alpha\frac{\partial Y}{\partial p} + (1-\theta)\alpha\beta\frac{\partial Y^*}{\partial p^*} \tag{18}$$

Proceeding in a similar fashion as in the Part 1 of this appendix, we get the following tax in the presence of given lobby: For the national lobby:

$$t = \frac{\alpha\left(\omega + a^{NG}\right)\left(\delta + \beta\delta(1-\theta) - 1\right)}{\omega\left(\delta - 1\right)}$$

For the local greens:

$$t = \frac{a^{LG}\alpha\theta}{\omega} + \frac{\alpha\left(\delta + \beta\delta(1-\theta) - 1\right)}{(\delta - 1)}$$

And finally, for the supergreens:

$$t = \frac{a^{GG}\alpha\left[\delta(1-\theta)(1+\beta) - (1-\theta)\right]}{\omega(\delta-1)} + \frac{\alpha\left[\delta + \beta\delta(1-\theta) - 1\right]}{\delta - 1}$$