Free Trade and the Burden of Domestic Policy

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Abstract: Consider a small economy facing accession to a exogenously defined trade agreement. Before accession, the government controls trade and pollution policy. After accession, it retains control over pollution policy, but must allow free trade in all goods. This is a choice many governments face while joining trade agreements today. They decide whether greater market access to other members is more valuable than control over trade policy. I ask two questions. All else being equal what happens to environmental policy after accession? Second, what affects the choice of accession and how does this choice impact aggregate welfare? I show that a loss in control over trade policy alters the political incentives determining environmental policy. Before accession (when prices are endogenous), producers can transfer a portion of their burden of environmental regulation to consumers through price increases. After accession (when free trade is adopted) the same regulation is borne entirely by producers. Due to the change in burden accompanying free trade there exist plausible conditions under which the adoption of free trade can lead to more stringent environmental regulation, a reduction in the preferential treatment of special interest groups, and an increase in aggregate welfare.

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1 Introduction

Free trade can shift the burden of domestic producer policy from consumers to producers. When prices are endogenous, producers can transfer some of their burden of regulation onto consumers through an increase in prices. However, once prices are determined in the world market, a transfer of burden is no longer possible. In a small open economy the burden of regulation is borne entirely by the regulated producers.[1] This difference in who bears the burden of regulation has important political economy implications. In this paper I use the context of environmental regulation to illustrate these implications.

I consider a scenario reflecting the choice many governments make while joining multilateral trade agreements today. A small economy faces accession to a trade agreement. Due to its size this economy has limited influence in setting the agreement's agenda and joining the trade agreement is similar to adopting exogenously determined trade policy.[2] Before accession, the government has full control over both trade and pollution policy. After accession, it retains control over pollution policy, but must allow free trade in all goods. Thus, while accession brings greater market access to other members it also implies losing control over trade policy.

By modeling this choice I evaluate two recurring questions in the literature linking trade and environmental policy. First, all else being equal, what happens to environmental policy when free trade is adopted? There is a significant literature addressing this question (discussed in greater detail in the next section). However, these articles do not include the effects of a change in the burden of environmental policy that results from free trade. Second, what affects the choice of free trade and how does this choice impact environmental policy and aggregate welfare?

I find plausible conditions under which the choice of free trade is accompanied by an improvement in pollution policy and a gain in aggregate welfare. Unlike some articles in this literature,[3] I find that this gain in welfare can occur even if pollution policy is less stringent than socially optimal

[1] I present the case of a small economy. By definition, a small economy has no influence on domestic prices once free trade is adopted. However, this is not necessary for the results presented. Greater competition and larger markets in free trade reduce the influence on domestic prices even for large economies.

[2] Consider accession to the World Trade Organization as an example. During a period before accession, market access to current members, and rules for accession are negotiated. Further, most new policies are finalized only after negotiations with all members. Despite the World Trade Organization's democratic nature, it is well accepted that the bargaining power of small economies is considerably smaller than the larger economies. Also as there are currently 144 members of the World Trade Organization, a single small economy usually does not have considerable impact on the negotiated policy (please see http://www.wto.org for more details).

[3] See for example, Chichilinsky (1994), and Brander and Taylor (1997, and 1998).

and the economy exports the polluting good. Before accession, both trade and pollution policy are used to redistribute income to special interest groups. With any increase in the pollution tax the government also increases the tariff on the polluting good. This increase in tariff partially offsets the loss in profits from the increase in pollution tax but also transfers some of the burden of the pollution tax onto consumers. Once free trade is adopted, the tariff rate cannot be altered. Domestic prices are exogenously given and the burden of pollution tax on producers rises. I find that this change in burden causes pollution to be more responsive to increases in tax. Given certain assumptions, this induces the government to increase the pollution tax bringing it closer to the social optimum. In addition, if the price for the polluting good under free trade is higher than the domestic price before free trade (for example, due to improved market access from accession) free trade also brings about a gain in aggregate welfare.

There are two main contributions of this paper. The first is to highlight how losing control over domestic prices (say through a loss in control over trade policy) can change the burden of domestic policy and impact political equilibria. The intuition presented here is broader than the environmental context adopted. When domestic prices are endogenous the burden of domestic producer based regulation (for example: labor standards, product standards, output and input taxes) can be transferred to consumers. In free trade such transfers are not possible. The political effects presented are likely to be valid in the context of other producer-based regulation.[4] The second contribution is to present conditions under which choosing free trade improves pollution policy and reduces the aggregate welfare loss created by favoring special interest groups.

The remainder of the paper is structured as follows. In Section 2, I discuss the relationship of this paper to the existing literature. In Section 3, I present the model. In Section 4, I analyze pollution and trade policy for an economy before accession (where the government has full control over both pollution and trade policy). In Section 5, I explore pollution policy after accession (under free trade). I conclude in Section 6.

[4]Bagwell and Staiger (2000) argue that free trade reduces the economic burden of a labor standard on consumers, but increases it on the producers of the good. However, they do not explore the political incentives that arise from this change.

2 Relation to Earlier Literature

This paper is a part of the literature that explores the political economy of trade and environmental policy.[5] Fredriksson (1997), and Aidt (1998) analyzed pollution policy in the presence of lobbying and illustrated deviations of the pollution tax from social optimal. Bommer and Schulze (1999) showed that increased environmental protection is compatible with trade liberalization. Schleich (1999) extended the literature by including lobbying over trade policy. The author illustrated how in the presence of lobbying, inefficient trade based policies can lead to better environmental quality than efficient production based policies. Schleich and Orden (2000) extended this idea by studying the choice of efficient and inefficient policies. They showed that lobby groups can prefer inefficient policies leading to higher environmental quality outcomes. Fredriksson and Gaston (1999) illustrated why trade unions prefer stricter environmental policy when their jobs are secure and job cuts from environmental policy are borne by non-unionized workers. Damania and Fredriksson (2003) endogenized the collective action necessary to form a lobby. They showed how trade liberalization can strengthen environmental policy by reducing the ability of industries to form lobbies.

This paper is distinct from all the above papers as it investigates how free trade can alter the burden of domestic environmental policy and change political equilibria. There is a similarity to Schleich (1999), and Schleich and Orden (2000) as trade and environmental policies are both endogenized. However, unlike these two papers, I also focus on how the choice of free trade effects environmental policy and not on the effect of efficient versus inefficient instruments on environmental quality. There is also a similarity to Bommer and Schulze (1999) and Damania and Fredriksson (2003) as I provide conditions under which trade liberalization can improve pollution policy. However, in these papers the tariff, and trade liberalization is exogenous. In the current paper both the tariff rate and the choice of free trade are endogenously chosen.

McAusland (2003 and 2007) and Yu (1999) have previously recognized the impact of free trade on the burden of pollution policy. McAusland (2003) investigated how voting patterns depend on the ownership of clean versus dirty industries. She showed that the burden of pollution policy is shared in autarky and this can make both the owners of clean and dirty industries prefer weaker environmental policy. However, in free trade only the owners of dirty industries prefer weaker

[5] See Copeland and Gulati (2006) and Copeland and Taylor (2004) for a comprehensive survey of articles studying the impact of international trade on the environment.

environmental policy. McAusland (2007) highlighted the difference in lobbying across consumer generated and producer generated pollution. In autarky, producers share in the burden of consumer based pollution policy and thus prefer weaker environmental policy. In free trade, producers are indifferent to consumer based environmental policy. This shift in burden allows the government to raise the consumer based pollution tax in free trade. Yu (1999) investigated the success of environmental groups while competing with polluting industries to influence environmental policy and as a minor part of his analysis, studied the effects of free trade on environmental protection. All three papers (McAusland 2003, 2007, and Yu 1999) showed that free trade can be accompanied by an increase in the stringency of environmental policy.

There are a few important differences between the above papers and the current one. First, these articles compare pollution policy across autarky and free trade. Instead in this paper I compare the situation where the domestic polluting industry is 'protected' using a tariff with free trade. Second, in this paper the government can choose the tariff level and the adoption of free trade, while in the above papers the trade regime was exogenously given. Lastly, while in all three above papers free trade can increase the stringency of policy, the pollution tax in free trade is further away from the welfare maximizing policy than it was under autarky. In contrast in this paper I present conditions under which the pollution tax increases and also becomes closer to the social optimum. Unlike the above papers, in this paper the choice of free trade induces the government to better represent aggregate preferences, and reduces the influence of special interests.

3 The Model

Consider a small economy with two goods: one numeraire and one non-numeraire. Production of the numeraire good (denoted y_0 - price is normalized to unity) uses a linear technology with a single input: labor (l_0); the production function is $y_0 = l_0$. We assume that the stock of labor is large enough to ensure positive production of the numeraire good throughout (in any equilibrium that involves production of the numeraire good, wage $w = 1$).

Production of the non-numeraire good y produces pollution (z) as a by-product. The two outputs y and z are jointly produced by a convex technology using two inputs: sector-specific polluting capital (k), and labor (l). Returns to the owners of polluting capital (k) are represented

by a restricted profit function,

$$\pi^k(t,p) = \widetilde{\pi}^k(t,p,w;k),$$

where t is the tax on pollution, and p is the domestic price of the non-numeraire polluting good. Restricted profit functions are positively linearly homogeneous, convex in prices (t,p,w), and satisfy Hotelling's Lemma. Thus output is $y(t,p) = \pi_p^k(t,p)$ and the production of pollution is given by $z(t,p) = -\pi_t^k(t,p)$.

All consumers have quasi-linear utility functions. The sub-utility function for the non-numeraire good is denoted $u(x)$ and is strictly increasing and concave. Damage from pollution is separable and is represented by a strictly increasing and convex function $v(z)$. Given the quasi-linear structure, demand for the non-numeraire good is purely a function of its price. Demand is denoted $x(p)$ and

$$\gamma(p) = [u(x(p)) - px(p)] \tag{1}$$

represents consumer surplus. Assume that each consumer is endowed with a single unit of labor and total consumer population is normalized to 1. Consumer income is a combination of wages and government transfers. Government transfers comprise of pollution tax revenues tz, and tariff revenues (T) (when imposed).

There are three types of economic agents in this economy. There are the two types of consumers. The first set of consumers are organized and lobby the government to influence policy. Their indirect utility function comprises of consumer surplus, wage income and government tax returns and damage from pollution. It is represented as

$$w^h(t,p) = n_h[1 + \gamma(p) - v(z) + tz + T], \tag{2}$$

where n_h is the proportion of consumers organized as a lobby group. The second type of consumers are not organized. Their indirect utility function is given by

$$w^l(t,p) = n_l[1 + \gamma(p) - v(z) + tz + T], \tag{3}$$

where n_l is the proportion of consumers unorganized and $n_h + n_l = 1$. Note that the indirect utility function of those who are not organized is the same as those who are organized.[6]

[6] I do not model the process by which some consumers organize while others do not. This is similar to Grossman and Helpman (1994) where the ability to form a lobby group for industries is assumed to be exogenously given.

The third set of agents are the owners of polluting capital k. We assume that the ownership of k is highly concentrated (thus producers comprise a negligible proportion of society). This implies that we can approximate the welfare for the owners of polluting capital k as being equal to profits (as there is a negligible amount of consumer surplus, government revenues and pollution damages that accrues to them). Thus

$$w^k(t,p) = \pi^k(t,p). \tag{4}$$

4 Endogenous Trade and Pollution Policy: A Pre-Accession Economy

Before accession the government has full control over trade and pollution policy. The politically motivated government sets a trade tariff ($\tau \gtreqless 0$) and a pollution tax t on the polluting good. Domestic price ($p = p^* + \tau$) equals the world price plus the tariff. Total tariff revenue collected (or disbursed as a subsidy) is $T = \tau m(t,p)$, where $m(t,p) = x(p) - \pi_p^k(t,p)$ is the net import or export of the non-numeraire polluting good.

4.1 The Social Planner's Benchmark

As a benchmark consider the social planner's optimal policy. The social planner chooses the pollution tax and tariff to maximize aggregate welfare. Aggregate welfare $W(t,\tau;p^*)$ is the sum of all individual group welfare in society, this includes consumer welfare, rents accruing to the specific factor, tax and tariff revenues. The social planner's problem is

$$\max_{t,\tau} W(t,\tau;p^*) = \sum_{i\in\{k,h,l\}} w^i = 1 + \gamma(p) - v(z) + tz + \tau m + \pi^k(t,p). \tag{5}$$

Let $z_t = -\pi^k_{tt}$, $z_p = -\left[\pi^k_{tp}\right]$, $m_t = \left[-\pi^k_{pt}\right]$ and $m_p = \left[x_p - \pi^k_{pp}\right]$ be shorthand for the respective derivatives. Using this notation, the first order condition for the welfare maximizing pollution tax (t_w) is

$$W_t = [t_w - v_z]\,[z_t] + \tau_w[m_t] = 0, \tag{6}$$

By raising the pollution tax the government equates the resultant reduction in pollution damages ($[v_z]\,[-z_t]$) and a gain in tariff revenues ($\tau_w[m_t]$) to the loss in pollution tax revenues ($[t_w]\,[z_t]$). The first order condition for the tariff (τ_w) is

$$W_\tau = [t_w - v_z]\,[z_p] + \tau_w[m_p] = 0, \tag{7}$$

By raising the tariff the government equates the increase in pollution tax revenues minus the increased pollution damages from excess production ($[t_w - v_z]\,[z_p]$) to the resultant second order decrease in tariff revenues ($\tau_w[m_p]$). The solution to these two first order conditions gives us the welfare maximizing pollution tax,

$$t_w = v_z. \tag{8}$$

The welfare maximizing pollution tax equals marginal social damage from pollution. This is the standard Pigouvian prescription for treating externalities. From the same conditions the optimal tariff for our small open economy is

$$\tau_w = 0. \tag{9}$$

As the externality is fully internalized through the pollution tax the optimal tariff for a small open economy equals zero.

4.2 Politically Chosen Policy

The government maximizes a weighted welfare function where the welfare of special interest groups (profits of domestic producers and the welfare of organized consumers) gets a higher weight than the rest of society.[7] Formally the maximization problem for the government is

$$\max_{t,\tau} G\left(t,\tau;p^*\right) = \beta\left(\pi^k\left(t,p\right) + w^h\left(t,p\right)\right) + W\left(t,\tau;p^*\right), \tag{10}$$

where $\beta > 0$.

The first order condition that determines the politically optimal pollution tax rate (t_o) is

$$G_t = \beta\left[1-n_h\right]\pi_t^k + \left[1+\beta n_h\right]\left[\left[t_o - v_z\right]\left[z_t\right] + \tau_o[m_t]\right] = 0. \tag{11}$$

On rearranging and using the definitions for z_t and m_t the optimal pollution tax can be expressed as

$$\left[t_o - v_z\right] = \frac{\beta\left[1-n_h\right]}{\left[1+\beta n_h\right]}\frac{\pi_t^k}{\pi_{tt}^k} + \tau_o\frac{\left[-\pi_{pt}^k\right]}{\pi_{tt}^k}. \tag{12}$$

The politically optimal pollution tax differs from marginal social damage due to two terms. The first term on the right hand side of equation (12) reflects the government's preference for special

[7] Please see Grossman and Helpman (1994) for the micro-foundations for this weighted welfare function. The authors show that government policy obtained from maximizing the above weighted welfare function is equivalent to government policy chosen under the following conditions: a) the government collects political contributions, b) the producers of the non-numeraire good are organized as a political lobby, and c) the contribution function offered by the producers is differentiable.

interest groups. The numerator of this term is the direct burden to organized special interest groups from an increase in pollution tax ($-n_l z = [1 - n_h]\,\pi_t^k < 0$).[8] The denominator is the weighted responsiveness of pollution to pollution tax ($[1 + \beta n_h]\,[-z_t] = [1 + \beta n_h]\,[\pi_{tt}^k] > 0$). The responsiveness of pollution reflects the welfare cost of supporting special interest groups. This is because a high responsiveness implies a large increase in pollution from reducing the pollution tax.

The second term on the right hand side of equation (12) depends directly on the degree of tariff protection granted to the polluting good. This term reflects the use of the pollution tax as a second-best tool to reduce the impact of the trade distortion. If the polluting good is *protected* ($\tau > 0$), the pollution tax is adjusted upwards. If the polluting good is *discriminated against* ($\tau < 0$), the pollution tax is adjusted downwards. This adjustment of the pollution tax for tariff also illustrates the substitution between the pollution tax and tariff in the government's objective.[9]

The first order condition that determines the politically optimal tariff (τ_o) is

$$G_\tau = \beta\,[1 - n_h]\,\pi_p^k + [1 + \beta n_h]\,[[t_o - v_z]\,[z_p] + \tau_o[m_p]] = 0. \tag{13}$$

Rearranging the first order condition and using the definitions for m_p and z_p we get

$$\tau_o = \frac{\beta\,[1 - n_h]}{[1 + \beta n_h]}\frac{\pi_p^k}{\left[\pi_{pp}^k - x_p\right]} + [t_o - v_z]\,\frac{[-\pi_{tp}^k]}{\left[\pi_{pp}^k - x_p\right]}. \tag{14}$$

Once again the politically chosen tariff differs from the social optimum (zero) on account of two terms. The first term on the right hand side of equation (14) allows an increase in tariff due to the extra weight to special interest groups. The numerator is the gain from an increase in tariff (π_p^k), and the denominator tempers this effect by the responsiveness of imports to price ($\left[\pi_{pp}^k - x_p\right]$). The second term once again illustrates the substitution between the pollution tax and tariff in achieving the government's objectives. If the pollution tax for the polluting good is less than marginal social damage, the tariff on the polluting good is lower. However if pollution tax is greater than marginal social damage, the tariff is higher.

In order to capture the effect of the substitution between tariffs and taxes in the government's welfare function we need to solve for the equilibrium pollution tax after accounting for the equilibrium tariff from equation (14). This expression for the optimal pollution tax once we account for

[8] More specifically this is the increase in pollution tax payments returned to unorganized consumers.

[9] Please see Appendix A.2 for a formal discussion of the conditions for substitutability.

the endogeneity of the tariff is

$$[t_o - v_z] = \frac{\beta\,[1-n_h]}{[1+\beta n_h]} \frac{\pi^k_t + \pi^k_p \frac{[-\pi^k_{tp}]}{[\pi^k_{pp}-x_p]}}{\pi^k_{tt} - \frac{[-\pi^k_{tp}]^2}{[\pi^k_{pp}-x_p]}}. \tag{15}$$

On accounting for the endogeneity of the tariff the optimal pollution tax reflects the complete response in policy and not just the partial changes from an increase in the pollution tax. The numerator of the first term on the right hand side of equation (15) is now the total burden to organized special interest welfare from an increase in the pollution tax. This includes the partial loss in producer profits (π^k_t) plus the transfer in the burden of the pollution tax to unorganized consumers that occurs due to an adjustment of tariff accompanying the increase in the pollution tax ($\pi^k_p \frac{[-\pi^k_{tp}]}{[\pi^k_{pp}-x_p]}$). The denominator is still the responsiveness of pollution to pollution tax. However, as the tariff and pollution tax adjust together this responsiveness is different from the partial responsiveness. As producers share some of their burden from a pollution tax through the tariff their responsiveness of pollution to a pollution tax is smaller ($\pi^k_{tt} - \frac{[\pi^k_{tp}]^2}{[\pi^k_{pp}-x_p]} < \pi^k_{tt}$).

4.2.1 Special Case: Only Organized Consumers Consume The Polluting Good

Consider a special case of the above model where only organized consumers consume the polluting good. This case is relevant for modelling pollution generated in intermediate industries. A majority of the most pollution-intensive industries are intermediate good industries (see Hettige et al. 1992, 1995, and Stern et al. 1997 for evidence). If we assume that the intermediate using industry is also organized then only organized consumers consume the polluting good. In addition, low, or negligible consumption of the polluting good by unorganized citizens is also realistic for some developing countries (like those in South Asia). In these countries the urban rich have significant influence in policy making. The urban rich also consume a majority of manufactured products. The unrepresented poor live a subsistence lifestyle, depend on mud and clay housing, practice subsistence agriculture, and have almost no demands on the modern manufacturing sector.

To conform with the assumption that only organized consumers consume the polluting good the indirect utility functions change. The indirect utility function for organized consumers is

$$w^{hs}(t,p) = n_h \left[1 + \frac{[\gamma\,(p^* + \tau) + \tau m]}{n_h} - v\,(z) + tz\right]. \tag{16}$$

Organized consumers earn labor income, receive consumer surplus from consumption of the polluting good, receive a transfer of tariff and pollution tax revenues, and suffer damages from pollution.

The indirect utility function for unorganized consumers is given by

$$w^{ls}(t,p) = n_l\left[1 - v(z) + tz\right]. \tag{17}$$

On the other hand, unorganized consumers earn labor income, get a transfer of pollution tax revenues and suffer damages from pollution.[10]

In this special case the optimal pollution tax (denoted t_{os}) is

$$[t_{os} - v_z] = \frac{\beta\left[1 - n_h\right]}{\left[1 + \beta n_h\right]} \frac{\pi_t^k}{\pi_{tt}^k - \frac{[-\pi_{tp}^k]^2}{\left[\pi_{pp}^k - x_p\right]}}. \tag{18}$$

As only organized groups consume the polluting good the burden of the pollution tax cannot be transferred to unorganized consumers through an increase in tariffs. Thus it does not show up in the numerator of the term on the right hand side of equation (18). However, the responsiveness of pollution to pollution tax is still smaller when prices are endogenous. Thus the denominator remains the same.

5 Free Trade: A Post Accession Economy

On accession our economy has increased market access to other members of the trade agreement (which is modelled as a set of new goods prices). However, as explained earlier, accession also implies a loss in control over trade policies. After accession the government retains control over domestic pollution policy, but cannot have any barriers to international trade.

5.1 The Pollution Tax after Accession

Let the price of the polluting good post accession be denoted p_F. This price need not equal the world price (p^*) available before accession. Post accession free trade implies that all tariffs equal zero ($\tau = 0$) and thus domestic price equals the exogenously given world price ($p = p_F$).

[10] Note that the distribution of government revenues is different from that in Section 3. Pollution tax revenues are distributed equally to all individuals who incur pollution damage. Similarly, tariff revenues are distributed only to consumers who consume the regulated good. This is done to ensure that there is no asymmetry between the distribution of revenue and the distribution of the deadweight loss from policy. This also ensures that contributions from producers are not determined by the distribution of revenue, but only by a desire for greater profit.

The optimal politically chosen pollution tax post accession (t_F) is given by

$$t_F - v_z(z) = \frac{\beta[1-n_h]}{[1+\beta n_h]}\left[\frac{\pi_t^k}{\pi_{tt}^k}\right] \tag{19}$$

The first term on the right hand side of equation (19) is marginal social damage from pollution. Note that the numerator on the right hand side of equation (19) is the same as that on the right hand side of equation (18). However, the denominator is different. Recall the denominator is the weighted responsiveness of pollution to pollution tax. When prices were endogenous producers could transfer some of their burden of pollution tax onto consumers. Thus one unit of an increase in pollution tax translated into less than one unit borne by producers. Once free trade is adopted, producers bear the entire burden of pollution tax themselves. This implies that given the same production function a single unit increase in the pollution tax now implies a greater reduction in pollution (thus responsiveness rises). In other words, the responsiveness of pollution to pollution tax is higher is higher in free trade than when prices are endogenous ($\pi_{tt}^k > \pi_{tt}^k - \frac{[\pi_{tp}^k]^2}{[\pi_{pp}^k - x_p]}$).

5.2 Evaluating the Effect of Accession on the Pollution Tax

I now compare three pollution tax schedules described earlier. These are: the welfare maximizing tax, the political tax before accession and the political tax after accession.[11] For now, I assume that the domestic price before and after accession remains constant.[12] With a constant price I can evaluate the change in pollution policy independent of price effects. I discuss the effect of varying prices in the next sub-section.

In the following proposition I compare the welfare maximizing tax: t_w (from equation 8), the pre accession political pollution tax when all consumers (whether organized or not) consume the polluting good: t_o (from equation 15), and the pollution tax after accession: t_F (from equation 19).

Proposition 1 *Assume that a) the domestic price remains constant before and after accession, and b) the elasticity of non-numeraire output to the pollution tax is lower than the elasticity of pollution to the pollution tax. Then, accession involves a lowering of the politically optimal pollution tax rate, and further, the tax rates before and after accession are lower than the welfare maximizing tax. Formally,* $t_w > t_o > t_F$.

[11] In Appendix A.3 I present a similar comparison for the pollution tax across autarky and free trade.

[12] This implies that $p = p^F$ before and after accession. Before accession $p = p^* + \tau_o$, and after accession $p = p^F$. Thus we are assuming that, $\tau_o = p^F - p^*$.

Proof. Please see Appendix A.1. ■

This proposition states that accession is accompanied by a worsening of pollution policy. The conditions needed are: that all consumers consume the polluting good, that the output price remains constant, and a fairly innocuous assumption on elasticities of output and pollution to pollution tax.

While creating a distortion in the pollution tax the government considers the burden of the pollution tax on organized special interest groups (see numerator of right hand side of equation 15). It also accounts for the welfare cost of creating this distortion by considering the responsiveness of pollution to pollution tax (see denominator of right hand side of equation 15). On accession both these terms can change.

Consider first the burden of the pollution tax on organized special interest groups (the numerator). Before accession the government can create distortions in both the tariff and the pollution tax. As both distortions are created to support organized interest groups, these two instruments are substitutes in the government's welfare function.[13] If there is a reason for an increase in the pollution tax, there is an associated increase in tariff protection as well. Effectively, the political endogeneity of tariffs allows producers to transfer a portion of their pollution tax burden onto unorganized consumers. However on accession the tariff rate is exogenously fixed (at zero). This implies that the entire burden of the pollution tax is now borne by the organized domestic producers (see numerator in equation 19). In other words after accession the burden of the pollution tax on organized groups rises.

Next consider the change to the responsiveness of pollution to the pollution tax (the denominator). As only producers bear the burden, after accession the responsiveness of pollution to pollution tax rises. This implies that the welfare cost of creating a distortion in the pollution tax is higher after accession.

Given the conditions for this proposition I find that the effect of an increasing burden dominates the effect of increasing responsiveness. In other words, the government is more concerned about the increase in burden on organized groups and lowers the pollution tax once it accedes to the trade agreement.

In the next proposition I compare the welfare maximizing tax: t_w (from equation 8), the pre-accession political pollution tax when only organized consumers consume the polluting good: t_{os}

[13] Also see discussion after equations 12 and 14 and see Appendix A.2 for an explanation.

(from equation 18), and the pollution tax after accession: t_F (from equation 19).

Proposition 2 *Assume a) the domestic price remains constant before and after accession, b) only organized groups consume the polluting good. Then, accession involves an increase in the politically optimal pollution tax rate, and further, the tax rates before and after accession are lower than the welfare maximizing tax.. Formally,* $t_w > t_F > t_{os}$.

Proof. Please see Appendix A.1. ■

If the polluting good is consumed only by organized consumers, accession to free trade (with a constant price) improves pollution policy. Note that Proposition 2 contrasts with Proposition 1. Also unlike Proposition 1, no restriction on relative elasticities is required.

Recall that while creating a distortion in the pollution tax two factors are important. First the burden of the pollution tax on organized special interest groups (see numerator of right hand side of equation 18). Second the welfare cost of creating this distortion (from the responsiveness of pollution to pollution tax - see denominator of right hand side of equation 18).

The important difference between the above two propositions is in who consumes the polluting good. While in the Proposition 1 producers could transfer the burden of the pollution tax onto unorganized consumers in this proposition (2) only organized consumers consume the polluting good. This implies that even though on accession the burden shifts from being partly borne by consumers to being completely borne by producers, in both cases organized special interest groups bear the burden of the polluting tax (there is no change in the numerator across the pollution tax before and after accession). However, as earlier once producers bear the burden of the pollution tax the responsiveness of pollution to the pollution tax increases. This implies that the welfare cost of creating a distortion in the pollution tax is higher after accession.

As there is no change in the burden of the pollution tax on organized groups and the responsiveness of pollution to pollution tax is higher the government raises the pollution tax after accession. Due to the increased responsiveness we also find that the pollution tax after accession is closer to the social optimum than it was before accession.

5.3 The Welfare Effects of Accession

In this section I explore the welfare affects of accession to the trade agreement requiring free trade. As mentioned earlier, assume that the world price for the polluting good available after accession

is p_F (need not equal the world price p^* available before accession). For this section I also assume that only organized consumers consume the polluting good. This implies that the relevant pollution tax before accession is t_{os} (from equation 18). Let τ_{os} denote the politically chosen tariff before accession. Correspondingly let $p_{os} = p^* + \tau_{os}$ denote the domestic price prevalent before accession.

The government chooses accession if and only if the following inequality holds.

$$G\left(t_F, \tau = 0; p_F\right) \geq G\left(t_{os}, \tau_{os}; p^*\right). \tag{20}$$

In other words, the government chooses accession to the trade agreement if and only if its welfare after accession is higher than before accession. Besides policy variables this inequality also depends on the price of the polluting good prevalent before and after accession.

Before we analyze the welfare effect consider some preliminary results. Let $\tilde{p}$ denote the post accession price where the pollution tax after accession equals the pollution tax before accession. Let $t_F\left(.\right)$, and $t_{os}\left(.\right)$ denote implicit functions derived from equations (19) and (18) respectively, then $\tilde{p}$ is formally defined by

$$t_F\left(\tilde{p}\right) = t_{os}\left(p_{os}\right). \tag{21}$$

Assuming that the pollution tax and world price are substitutes in the governments welfare function (conditions are provided in Appendix A.2) we can assert that the pollution tax rises when the world price rises. Under these conditions we know that

$$p_F \geq \tilde{p} \Rightarrow t_F \geq t_{os}. \tag{22}$$

In other words, if the world price for the polluting good is higher than the price where pollution taxes are equal, the pollution tax in free trade is also higher.

Corollary 1 *If unorganized consumers do not consume the polluting good then the price where pollution taxes are equal is lower than the domestic price before accession ($p_{os} > \tilde{p}$).*

This result is a straightforward Corollary to Proposition 2 which shows that at a constant price for the polluting good the pollution tax after accession is higher than the pollution tax before accession. Thus a reduction in the price after accession lowers the pollution tax and brings it closer to that before accession.

In the following proposition I present the welfare implications of accession when unorganized consumers do not consume the polluting good.

Proposition 3 *Assume that only organized groups consume the polluting good. If* $p_F \geq \tilde{p}$ *then aggregate welfare after accession (under free trade) is higher than aggregate welfare before accession (when tariffs are endogenous).*

Proof. Please see Appendix A.1. ■

The above proposition implies that when unorganized agents do not consume the polluting good and the price of the polluting good is higher after accession, the choice of free trade is accompanied by an increase in aggregate welfare.

Given these conditions when the economy accedes to the trade agreement it gains from increased trade (which implies higher profits in the non-numeraire sector). It also gains from the removal of the trade distortion (the tariff). However, aggregate welfare can fall due to a potential increase in the untaxed pollution externality. This is possible as after accession production of the polluting good rises and pollution policy is still not welfare maximizing. However, I find that the improvement in the pollution tax (which brings it closer to social optimum) along with the increase in price ensures that more of the pollution externality is internalized using the pollution tax after accession (this is shown in the Proof of Proposition 3 in Appendix A.1). Thus despite the fact that production of the polluting good rises after adopting free trade, aggregate welfare rises.

This result contrasts with a subset of the results in the literature. Using the context of an extracted renewable resource, Chichilnisky (1994), and Brander and Taylor (1997, and 1998) showed that a country that exports the renewable resource harvested under incomplete property rights has lower aggregate welfare under free trade than autarky. In these papers the increase in the externality from increased production under incomplete property rights is higher than the gain from increased trade. In these papers property rights were exogenous. This implied that if free trade exacerbated the negative externality from harvesting, property rights could not adjust in response. In addition, trade regimes were also exogenously given. Thus, if adopting free trade lowered welfare the country did not have a choice to reject free trade. In this paper pollution policy is endogenous and the government can choose free trade. This allows a more complete analysis of the effects of choosing free trade on aggregate welfare.

6 Conclusion

This paper presents an analysis of the interaction between international trade and environmental policy. Tariffs, pollution policy and accession to a trade agreement are all influenced by special interest politics. If the polluting good is consumed by consumers organized as special interest groups (for example in the case of polluting intermediate goods) accession to a free trade agreement can bring about an improvement in pollution policy and a gain in aggregate welfare. This increase in aggregate welfare can occur even when environmental regulation is imperfect and the pollution intensive good is exported.

The improvement in welfare and pollution policy comes from a change in the burden of pollution tax. The burden of pollution tax changes as the country loses its ability to influence the domestic price of the polluting good. To highlight the loss in ability this paper presents the case of a small economy which has no ability to influence domestic prices once free trade is adopted. However, this assumption is not necessary. Greater competition and larger markets in free trade reduce the ability to influence domestic prices even for large countries.

One needs to interpret the results presented in this paper with caution. The proportion of polluting good consumed by unorganized agents determines whether pollution policy improves or deteriorates once free trade is adopted. This implies that an understanding of the type of good is important before one draws any conclusions from this research.

Finally, this analysis also provides the following hypotheses for empirical verification. *Ceteris paribus*, in a country environmental regulation should be more stringent for traded intermediates than for non-traded intermediate goods. A cross country variant would be: *ceteris paribus*, countries trading pollution intensive intermediate goods should have more stringent environmental regulation than countries that impose barriers on the trade of such goods.

References

[1] Aidt, Toke S. (1998), "Political Internalization of Economic Externalities and Environmental Policy", *Journal of Public Economics* 69(1), pp. 1-16.

[2] Bommer, R. and G. G. Schulze,(1999) "Environmental Improvement with Trade Liberalization," *European Journal of Political Economy,* 15, 639-661.

[3] Brander J. and M. Taylor, (1998) "Open Access Renewable Resources: Trade and Trade Policy in a Two-Country Model" *Journal of International Economics,* 44(2), 181-209.

[4] Brander J. and M. Taylor (1997) "International trade between consumer and conservationist countries." *Resource and Energy Economics,* 19, 267-297.

[5] Chichilnisky, G. (1994) "North-south trade and the global environment." *American Economic Review,* 84(4), 851-874.

[6] Copeland B. and S. Gulati (2006), "Trade and the Environment in Developing Countries." *Economic Development and Environmental Sustainability: New Policy Options*, The Initiative for Policy Dialogue Series, Series Editor: Joseph E. Stiglitz, Volume Editors: Ramon E. Lopez, and Michael Toman, Oxford University Press, New York.

[7] Copeland B. and M. Scott Taylor (2004), "Trade, Growth and the Environment," *Journal of Economic Literature*, March 2004.

[8] Damania R., and P.G. Fredriksson (2003), "Trade Policy Reform, Endogenous Lobby Group Formation, and Environmental Policy," *Journal of Economic Behavior & Organization*, 52, 47–69.

[9] Fredriksson, P.G. (1997) "The political economy of pollution taxes in a small open economy." *Journal of Environmental Economics and Management* 33(1), 44-58.

[10] Fredriksson, P.G. and Noel Gaston (1999) "The "greening" of trade unions and the demand for eco-taxes." *European Journal of Political Economy* 15, 663-686.

[11] Grossman, G. and E. Helpman (1994) "Protection for Sale," *American Economic Review*; 84(4), 833-50.

[12] Hettige, H., P. Martin, M. Singh and D. Wheeler (1995) "IPPS: The Industrial Pollution Projection System." *Policy Research Working Paper,* The World Bank, Washington DC.

[13] Hettige, H., R.E.B. Lucas, and D. Wheeler (1992) "The Toxic Intensity of Industrial Production: Global Patterns, Trends and Trade Policy." *American Economic Review Papers and Proceedings,* 82, 478-481.

[14] McAusland, Carol (2007), "Trade, Politics, and the Environment: Tailpipe vs. Smokestack" *Journal of Environmental Economics and Management,* forthcoming.

[15] McAusland, Carol (2003), "Voting for Pollution Policy: The Importance of Income Inequality and Openness to Trade" *Journal of International Economics*, 61(2): 425-451.

[16] Schleich, Joachim (1999) "Environmental Quality with Endogenous Domestic and Trade Policies," *European Journal of Political Economy*, 15, 53–71.

[17] Schleich, Joachim and David Orden (2000), "Environmental Quality and Industry Protection with Noncooperative versus Cooperative Domestic and Trade Policies," *Review of International Economics,* 8(4), 681-697.

[18] Stern, P.C., T. Dietz, V. W. Ruttan, R. H. Socolow, and J. L. Sweeney, Editors; Committee on the Human Dimensions of Global Change, National Research Council (1997) "Environmentally Significant Consumption Research Directions", *National Research Council*, National Academy Press, Washington DC.

[19] Yu, Zhihao (April 1999) "Environmental Protection and Free Trade: Direct and Indirect Competition for Political Influence", Article in: *Three Essays in International Trade, Political Economy and Environmental Policy*, University of British Columbia.

A Appendix

A.1 Proofs

Proof. for Proposition 1. Both political tax schedules diverge from marginal social damage by a ratio that reflects the government's trade off between special interest profits and aggregate welfare. At a constant domestic price pollution is constant and thus marginal social damage is constant. This implies that the relationship between the pollution tax after accession and the pollution tax before accession depends on whether

$$\frac{\left[\pi_t^k\right]}{\pi_t^k + \pi_p^k \frac{[-\pi_{tp}^k]}{\left[\pi_{pp}^k - x_p\right]}} \lessgtr \frac{\left[\pi_{tt}^k\right]}{\pi_{tt}^k - \frac{[-\pi_{tp}^k]^2}{\left[\pi_{pp}^k - x_p\right]}}. \tag{23}$$

The left hand side of equation (23) is the ratio of special interest losses after accession to those before accession. The right hand side is the corresponding ratio of pollution responsiveness (greater than one). If the ratio of special interest losses is smaller than the ratio of responsiveness then the pollution tax after accession is higher than the pollution tax before accession. Now let $\varepsilon_{z,t} = \frac{-\pi_{tt}^k t}{\pi_t^k}$ denote the partial equilibrium elasticity of pollution to pollution tax, and $\varepsilon_{y,t} = -\frac{\pi_{pt}^k t}{\pi_p^k}$ denote the partial equilibrium elasticity of polluting good output to pollution tax. Assume, that the elasticity of pollution to pollution tax is higher than the elasticity of polluting good output to pollution tax ($\frac{\varepsilon_{z,t}}{\varepsilon_{y,t}} \geq 1$) and that the ratio of elasticities is constant. This implies that the right hand side is lower than the left hand side and we can show that the pollution tax before accession is higher (a similar argument is shown graphically in the next proof for proposition 2). ■

Proof. for Proposition 2. I present a graphical proof for this proposition. Assuming a fixed price p three fixed point solutions are graphed in t space (see Figure 1). These are $t_w = \xi(p, t_w)$, $t_F = \Theta(p, t_F)$, and $t_o = \zeta(p, t_o)$, where $\xi(p, t_w) = v_z\left(-\pi_t^k(p, t_w)\right)$, $\Theta(p, t_F) = v_z\left(-\pi_t^k(p, t_F)\right) + \frac{\beta[1-n_h]}{[1+\beta n_h]}\left[\frac{\pi_t^k(p,t_F)}{\pi_{tt}^k(p,t_F)}\right]$, and $\zeta(p, t_o) = v_z\left(-\pi_t^k(p, t_o)\right) + \frac{\beta[1-n_h]}{[1+\beta n_h]}\frac{\pi_t^k(p,t_F)}{\pi_{tt}^k(p,t_F) - \frac{[-\pi_{tp}^k]^2}{\left[\pi_{pp}^k - x_p\right]}}$. At a constant price ($p$) the following relationship between the three holds true: $\xi(p, t) > \Theta(p, t) > \zeta(p, t)$, that is, at every t the function $\xi(.)$ lies above $\Theta(.)$ which lies above $\zeta(.)$. Second order conditions guarantee that the curves intersect the 45^0 line t from above.[14]

Figure 1 illustrates the relation between the three tax rates. The politically determined tax in

[14] In addition to the second order conditions we can verify that $\frac{d}{dt}\left[\xi(p, t)\right] = -\pi_{tt}^k v_{zz} < 0$, thus all three curves are downward sloping as drawn in the graph.

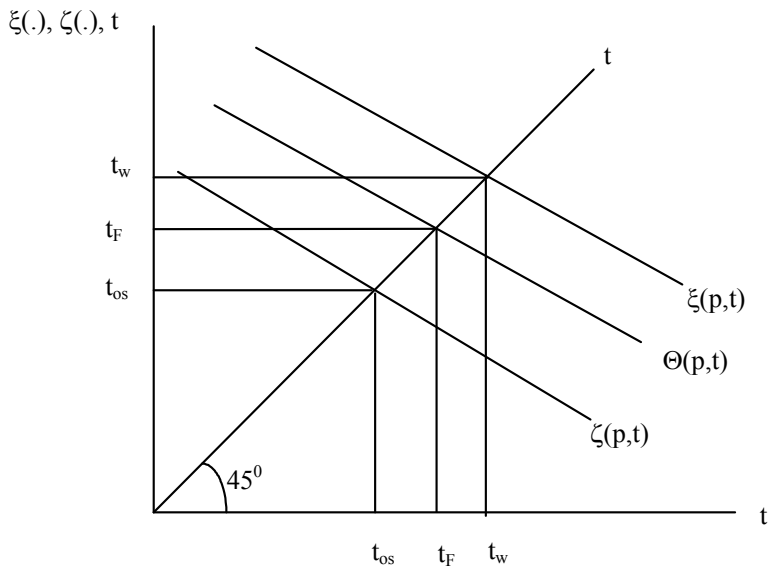

Figure 1: Pollution Taxes before and after Accession

free trade is smaller in value than the welfare maximizing tax, but is greater than the politically determined tax when tariffs are endogenous. ■

Proof. for Proposition 3. For the proof we need a few preliminaries. Let z_F denote pollution post accession, and let z_{os} denote pollution before accession then, if $p_F \geq \tilde{p}$,

$$[t_F z_F - v(z_F)] - [t_{os} z_{os} - v(z_{os})] \geq 0.$$

This claim follows from the following. Convexity of $v(.)$ implies

$$[v(z_{os}) - v(z_F)] \geq v_z(z_F)[z_{os} - z_F].$$

Equation (19) shows that $v_z(z_F) \geq t_F$. Thus

$$[v(z_{os}) - v(z_F)] \geq t_F[z_{os} - z_F].$$

Given that $t_F \geq t_{os}$

$$[v(z_{os}) - v(z_F)] \geq t_{os} z_{os} - t_F z_F,$$

which can be re-arranged to yield the first inequality

$$[t_F z_F - v(z_F)] - [t_{os} z_{os} - v(z_{os})] \geq 0.$$

The above inequality with the defintion of unorganized consumer welfare from equation (17) implies that if $p_F \geq \tilde{p}$,

$$w^{ls}\left(t_F, p_F\right) - w^{ls}\left(t_{os}, p_{os}\right) \geq 0.$$

This implies that if the price of the polluting good is higher than $\tilde{p}$ then unorganized consumers always gain welfare after accesion. Now for the main part of the proof. Assume that aggregate welfare falls after accession, formally this implies that

$$\Big(\pi^k\left(t_F, p_F\right) - \pi^k\left(t_{os}, p_{os}\right) + w^{hs}\left(t_F, p_F\right) - w^{hs}\left(t_{os}, p_{os}\right)\Big) + \Big(w^{ls}\left(t_F, p_F\right) - w^{ls}\left(t_{os}, p_{os}\right)\Big) < 0. \tag{24}$$

For aggregate welfare to fall the welfare of special interest groups in aggregate should fall more than the gain in welfare for the unorganized group. Given $\beta > 0$ this condition also implies that

$$(1+\beta)\Big(\pi^k\left(t_F, p_F\right) - \pi^k\left(t_{os}, p_{os}\right) + w^{hs}\left(t_F, p_F\right) - w^{hs}\left(t_{os}, p_{os}\right)\Big) + \Big(w^{ls}\left(t_F, p_F\right) - w^{ls}\left(t_{os}, p_{os}\right)\Big) < 0, \tag{25}$$

and equation (20) does not hold. Thus if aggregate welfare after accession is lower than government welfare after free trade is also lower. This implies that if the government chooses accession then aggregate welfare also rises after accession. ■

Intuition for the Method of Proof for Proposition 3. The proof is by contradiction. When the pollution tax after accession is higher than that before accession, pollution tax revenues rise faster than the increase in the pollution externality. This implies that if unorganized consumers do not consume the polluting good, their welfare rises on accession. Thus if aggregate welfare declines after accession it occurs only if the decline in special interest welfare is larger than the gain in unorganized group welfare from accession. This creates a contradiction. A decline in special interest welfare large enough to lower aggregate welfare also implies that the government welfare also declines on accession (as the political government assigns a higher weight to special interest welfare). This implies that if aggregate welfare declines when $p_F \geq \tilde{p}$, accession is rejected. Thus if accession is accepted, aggregate welfare must rise.

A.2 Substitutability between the Pollution Tax and Tariff

The cross partial between the pollution tax and price in the government's welfare function determines the substitutability between the pollution tax and price (tariff) in our model. I first derive

the cross partial for the aggregate welfare function $W(t, \tau; p^*)$ defined in equation (5). Recall that we assumed: $z_p = -\pi_{tp} > 0$, that is pollution rises as the price of the polluting good rises. Taking a derivative of equation (6) around equilibrium we get

$$W_{tp} = W_{t\tau} = v_{zz}[-z_t][z_p] + [m_t] > 0. \tag{26}$$

The cross partial between the pollution tax and price (tariff) in the aggregate welfare function is positive. In other words, these two instruments are substitutes for a welfare maximizing government.

Next I derive the cross partial for the government welfare function $G(t, \tau; p^*)$ from equation (10). For the result in equation (22) we need to consider the cross partial of the government welfare function after accession, that is when $\tau = 0$. Taking derivatives of the first order condition (equation 11) around the equilibrium (with $\tau = 0$) we get

$$G_{tp} = \left[\left(1 + \beta n_h\right) v_{zz}[-z_t] - \beta\left(1 - n_h\right)\right][z_p] + \left(1 + \beta n_h\right)[[t_o - v_z][z_{tp}]]. \tag{27}$$

The sign of G_{tp} is ambiguous however if β is small and if the third order derivative ($z_{tp} = \left[-\pi^k_{ttp}\right]$) is either negative or small then the first term $\left(1 + \beta n_h\right) v_{zz}[-z_t][z_p]$ dominates and $G_{tp} > 0$. For our purposes we assume that the first term (which is the cross partial of the social welfare function) dominates and price and pollution tax are substitutes in the government's welfare function. The assumption that prices and the pollution tax are substitutes is also consistent with the often cited fear that a lowering of trade barriers will induce governments to weaken environmental regulation, and sacrifice environmental quality to keep their domestic producers competitive.

A.3 Comparing Autarky and Free Trade

In this subsection I compare the equilibrium pollution policies across autarky and free trade. Through this comparison I assume that only organized consumers consume the polluting good. This implies that the relevant group welfare functions are equations (16) and (17) from section 4.2.

In autarky the domestic price for the polluting good is determined by equating demand and supply of the polluting good. This implies that the following equation

$$x(p) = \pi^k_p(t, p), \tag{28}$$

determines the domestic price for the polluting good. Taking a total derivative we can derive the

effect of an increase in the pollution tax on the price of the polluting good. Thus,

$$\frac{dp}{dt} = \frac{-\pi^k_{pt}(t,p)}{\left[\pi^k_{pp}(t,p) - x_p(p)\right]} > 0.$$

The government maximizes its political welfare in autarky by choosing the pollution tax, taking equation (28) as given. There are no tariffs to choose. The optimal pollution tax in autarky (t_a) is

$$[t_a - v_z] = \frac{\beta[1-n_h]}{[1+\beta n_h]} \frac{\pi^k_t}{\pi^k_{tt} + \pi^k_{tp}\frac{dp}{dt}}.$$

In free trade the government chooses the optimal pollution tax and takes the world price p_F as given. Once again there are not tariffs to choose from and now equation (28) need not hold. The optimal pollution tax in free trade (t_F) is the same as that in equation (19). This is reproduced below,

$$t_F - v_z(z) = \frac{\beta[1-n_h]}{[1+\beta n_h]} \left[\frac{\pi^k_t}{\pi^k_{tt}}\right]. \tag{29}$$

Using the same logic as that in Proposition 2 we can assert that at a constant price the pollution tax in free trade is closer to marginal social damage than the pollution tax in autarky. Thus adoption of free trade brings about an improvement in pollution policy.