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ENVIRONMENTAL PROTECTION  
WITH POLICIES FOR SALE

by  
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## **Environmental Protection with Policies for Sale**

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## ABSTRACT

This paper generalizes the Grossman-Helpman political economy model to characterize the structure of environmental and industry protection for a small open economy when domestic and/or trade policies are the outcome of a noncooperative common agency game between sector-specific producer lobbies and the government. For a consumption externality, the political equilibrium results if domestic and trade policies are available, are production-enhancing protection of organized industries, but the same environmental protection as Pigouvian taxes. Subsidies to organized industries counterbalance environmental taxes when there is a production externality, and it is ambiguous whether domestic or trade policy alone leads to more environmental protection. In addition, this paper demonstrates that the original Grossman-Helpman results arise as a special case that rests on the assumption that only trade policies are available to the government.

## **Environmental Protection with Policies for Sale**

### **I. INTRODUCTION**

Over the last two decades trade and environment policy issues have gained considerable attention. The traditional approach to analyzing environmental policy-making has encompassed a benevolent government choosing instruments and their levels to maximize a social welfare function that includes the costs and benefits of the environmental externality (Markusen 1975, Baumol and Oates 1988, Krutilla 1991, Diao and Roe 1995). In these models, Pigouvian taxes directly linked to the source of the externality emerge as the optimal solution. Trade policies, such as import tariffs, lead to deadweight losses and less environmental protection, so they are generally inferior to direct interventions such as effluent fees, input and output, or consumption taxes, depending on the cause of the market failure.

The distinction between trade and environmental policies has not been so clear in the political arena. While optimal domestic and trade policies can be conceptualized, as Anderson and Blackhurst (1992, p. 20) have noted, the trade and environment area has “an above-average risk of being exploited by special-interest groups to their own benefit and at the expense of the general interest.” Negotiations such as the Uruguay Round of GATT (1986-1993) have spurred lively discussions about trade and the environment in this context. Conversely, trade policy can conflict with environmental objectives: A well-known recent case involves U.S. production of sugar in Florida, which has been stimulated by protective import quotas, while at the same time state and national legislators have considered imposition of an output tax to reduce its devastating effects on the Everglades.

The above observations suggest that domestic and trade policies affecting environmental quality should be regarded as the simultaneous outcomes of a political process, and should be analyzed in a political economy framework. While the positive theory of policy-making has frequently been applied in international trade, there are only a few attempts that account for environmental concerns.<sup>1</sup> Among such formal political economy models is one developed by Hillman and Ursprung (1992). They analyze the impact of environmental interest groups on trade policies in a model of political competition in which candidates accept contributions to influence their chances of getting elected. Most other studies on the political economy of trade and the environment are descriptive (Hoekman and Leidy 1992, Klepper 1992). Both the positive political economy models and the empirical analyses are helpful in determining when welfare-enhancing trade and environmental policy reforms, as studied by Copeland (1994), Copeland and Taylor (1994, 1995), or Beghin, Roland-Holst, van der Mensbrugge and Metcalfe (1996), are politically feasible.

This paper takes an additional step in the direction of positive analysis of the policy outcomes when environmental externalities exist and organized interest groups lobby the government for political favors. The analysis presented herein builds on the political economy model developed recently by Grossman and Helpman (1994), in which the structure of protection for a small open economy facing fixed world prices is derived under the assumptions that the government has only trade policies available and that owners of some sector-specific factors are represented by industry lobbies.

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<sup>1</sup> For a recent overview on the political economy of trade policy see Rodrik (1995).

In the Grossman-Helpman political economy model, and its extension herein, the lobbies offer contributions to the government contingent on the levels of its policy decisions. Contributions are not primarily aimed at affecting the outcome of elections but rather to influence the government's policy stance. The government is assumed to maximize a weighted sum of the total contributions it receives and total consumer welfare. The lobbies' and the government's decisions are modeled as a first-price menu auction in a noncooperative common agency game with complete information, as developed by Bernheim and Whinston (1986). The government is the common agent whose actions are the policies, while each lobby is a principal whose bids are its contributions. Expressions for the equilibrium levels of policy interventions are derived assuming that preferences are quasilinear and identical across all individuals, that the contribution schedules are differentiable around the equilibrium point, and that the equilibrium is interior.

Two extensions of the basic Grossman-Helpman model are developed to address trade and environment political economy in this paper. First, it is assumed that consumption or production of one (or more) industry outputs generates a negative externality. Second, because the environmental externality naturally raises the question of optimal choice of policy instruments, it is assumed that domestic and/or trade policies may be available to the government. The domestic policies are either consumption or production taxes and subsidies, while the trade policies are taxes and subsidies on imports and exports. Extension of the model to allow choice among domestic and trade policies in the presence of externalities builds on results with multiple policy alternatives developed recently in Dixit (1996) and Schleich and Orden (1996): these extensions

demonstrate that the Grossman-Helpman political equilibrium results are special cases that test on the assumption that only trade policies are available to the government. For simplicity, it is assumed herein that the environmental externality is generated by the consumption or production activity itself, not by a particular input or production process. Hence, taxing consumption or production is equivalent to taxing the source of the externality, and such taxes provide the optimal policies to address the two externalities in a standard normative model.

The trade and environment political economy model developed herein retains the initial Grossman-Helpman assumption that only owners of some sector-specific factors are organized to lobby. The externalities are assumed to directly affect consumer well-being, and consumers are all assumed to care about the environment, but environmental interests are not organized. Since the government cares about total welfare and--via their contributions--especially about lobby members' welfare, environmental concerns are reflected in the government's objective function.<sup>2</sup>

Given the assumed structure of the political economy model, the equilibrium policies can be expressed as the sum of distinct political support and environmental effects. Whether these effects reinforce or counterbalance each other depends on the nature of the externality, whether the industry is organized, and whether the good is exported or imported.

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<sup>2</sup> Assuming that the government cares about the environment although environmental interest groups are not organized can be justified by the high political profile of environmental issues that is found in public opinion polls. Congleton (1996, p. 25), for example, finds that there is sufficient statistical evidence to conclude that general voter interests are not entirely neglected in environmental policy making.

Consumption policy alone, which does not affect producer prices in a small open economy, fails to give the government an instrument to satisfy industry lobbies. Hence, in the case of a consumption externality, the political equilibrium policy are standard Pigouvian consumption taxes when only consumption policy is available. If trade or production policy is also available, the political equilibrium interventions by the government are production-enhancing protection for organized industries, combined with consumer price policies that result in the same level of environmental quality as the Pigouvian taxes. This is not the outcome for a production externality because the domestic production policy not only serves the government to address the externality but--unlike the consumption policy--also to satisfy the lobbies. If a polluting industry is organized, environmental protection is lower than under a Pigouvian output tax.

An important finding of the analysis is that it is generally ambiguous whether domestic policy alone or trade policy alone leads to higher environmental protection, when the government is restricted to use only one or the other. This result is demonstrated for the case of a negative production externality. Using a production *subsidy* incurs a lower deadweight loss than using a trade policy (an import tariff or an export subsidy) for any given *level of protection* for an organized industry. Conversely, using a production *tax* generates a lower deadweight loss than a trade policy (an import subsidy or export tax) for any given *level of the externality*. The *net* outcome from use of only production policy, compared to use of only trade policy, depends on the relative magnitudes of the political support and environmental effects on the political equilibrium policies.



The remainder of the paper is organized as follows. The next section develops the methodology and derives the political equilibrium levels of domestic and trade policies for a small open economy when an externality is generated by consumption. Then the results are derived for a production externality. For both cases, results are compared when the government has both domestic and trade policies available or is restricted to only one policy.

## II. CONSUMPTION EXTERNALITY

### *1. Producers*

Following Grossman and Helpman (1994), assume there are  $(n + 1)$  goods in a small open economy. World and domestic prices for the numeraire good 0 are equal to one, and the vector of world prices for all nonnumeraire goods,  $p^w = (p_1^w, p_2^w, \dots, p_n^w)$ , is exogenous and constant. The numeraire good is made from labor alone, such that one unit of labor produces one unit of output. Thus, the wage rate for the entire economy is equal to one. The other goods are produced from labor and one inelastically supplied specific input, with constant returns to scale in both factors but diminishing returns to labor. This production structure leads to (aggregate) quasi-rents of  $\Pi_i(p_i^s)$  to the specific factor in industry  $i$  that only depend on the output price received by producers  $p_i^s$ .

Hotelling's Lemma provides the supply of industry  $i$ ,  $X_i(p_i^s) = \Pi_i'(p_i^s)$ , and

$\frac{\partial X_i}{\partial p_i^s} = X_i' > 0$ . Owners of the specific factor used in the production of good  $i$  have an

incentive to lobby for policies that raise  $p_i^s$  because a higher price increases their rents.

An exogenously determined subset  $L$  of all owners of specific factors are assumed to be organized to lobby by making contributions to the government.

## 2. Consumers

The population of  $N$  residents in the home country provide a total labor supply  $l$  and have identical, additively separable quasi-linear preferences. Each individual  $j$

maximizes  $u_j = c_{0j} + \sum_{i=1}^n u_{ij}(c_{ij}) + u_{Ej}(E)$ , where  $c_{0j}$  is the consumption of the numeraire

good,  $c_{ij}$  is the consumption of good  $i$  by individual  $j$ , and  $u_{Ej}(E)$  is the utility that

individual  $j$  derives from the state of the environment as determined by an externality  $E$ .

All  $u_{ij}(\cdot)$  are assumed to be increasing and concave functions, and, for specificity, it is

assumed that the externality is negative, that is  $\frac{\partial u_{Ej}}{\partial E} = u'_{Ej} < 0$  (the analysis holds

equally well if the externality is positive).

The externality  $E$  is generated, for each individual  $j$ , by the consumption of one or more of the nonnumeraire goods by all other individuals  $k$ . Assume that an

environmental externality created by consumption of some good  $e$  is simply  $E = \sum_{\substack{k=1 \\ k \neq j}}^N c_{ek}$ .

When an individual decides on her level of consumption of good  $e$ , she does not take into account the effects of her decision on other individuals' utility. Since all individuals' preferences are identical, the subscripts for the consumers can be dropped. Thus,

$$E = \sum_{\substack{k=1 \\ k \neq j}}^N c_{ek} = (N-1)c_e, \text{ with } \frac{\partial E}{\partial c_e} = E' = (N-1).$$

The consumer price vector is denoted  $\mathbf{p}^d = (p_1^d, p_2^d, \dots, p_n^d)$ . The quasi-linear preferences lead to ordinary demand functions that depend only on their own prices  $d_i(p_i^d)$  and all individuals have the same marginal utility of income equal to one. An individual's indirect utility can be expressed as  $v(\mathbf{p}^d, y, E) = y + s(\mathbf{p}^d) + u_E(E)$ , where  $y$  represents her income, and  $s(\mathbf{p}^d) = \sum_{i=1}^n u_i[d_i(p_i^d)] - \sum_{i=1}^n p_i^d d_i(p_i^d)$  is her consumer surplus from nonnumeraire goods. Individual demands are derived from Roy's Identity,

$d_i(p_i^d) = -\frac{\partial s}{\partial p_i^d}$ , and total domestic demand for any good  $i$  in the economy is

$$D_i(p_i^d) = Nd_i(p_i^d), \text{ with } \frac{\partial D_i}{\partial p_i^d} = D_i' < 0.$$

### 3. Government

The government is assumed to maximize a weighted sum of monetary contributions from organized industries and total consumer welfare. To do so, it can impose *ad valorem* consumption policies  $\tau_i$  and trade policies  $\theta_i$  on any of the nonnumeraire goods. The consumption policies drive a wedge between the prices that consumers and producers face, and the trade policies separate domestic producer and world prices. The price equilibrium conditions for the supply and demand of good  $i$  are  $p_i^s = \theta_i p_i^w$  and  $p_i^d = \tau_i \theta_i p_i^w$ . A consumption tax implies  $\tau_i > 1$ , while a consumption subsidy requires  $\tau_i < 1$ . An import tariff or an export subsidy implies  $\theta_i > 1$ , while an import subsidy or an export tax requires  $\theta_i < 1$ , depending on whether good  $i$  is imported or exported.

The net revenue of the government (excluding contributions by lobbies) is generated by its domestic and trade policies. Proceeds are derived from consumption and export taxes and from import tariffs, while expenditures are made for consumption, import, and export subsidies. The use of differentiated lump-sum taxes or subsidies as an independent policy instrument is ruled out by assumption, but the government's net revenue is redistributed evenly on a per-capita basis. The policy vector  $(\tau, \theta)$  generates net per-capita transfers

$$(1) \quad r(\theta, \tau) = \frac{1}{N} \sum_{i=1}^n p_i^s (\tau_i - 1) D_i(p_i^d) + \frac{1}{N} \sum_{i=1}^n p_i^w (\theta_i - 1) [D_i(p_i^d) - X_i(p_i^s)].$$

Contributions received by the government from organized interest groups are not part of the per-capita transfer (1). Instead, as Dixit, Grossman and Helpman (1996, p.16) explain, "they might be used by the governing party for its reelection campaign, or by a governing dictator for his own consumption." Contributions do not enter the subsequent market equilibrium conditions of the model, except to imply a decrease in income of owners of the sector-specific factors utilized in organized industries. The government is assumed to be concerned about total welfare as well as contributions either because consumer well-being also influences its chances for reelection or for (unspecified) ethical reasons.

#### 4. *Equilibrium*

In the first stage of the two-stage noncooperative game, lobbies simultaneously and noncooperatively set their contribution schedules as functions of domestic and trade policies  $C_i(\tau, \theta)$ . In the second stage, the government chooses  $\tau$  and  $\theta$  simultaneously.

Starting with the second stage, the government is assumed to maximize the weighted sum of total contributions and total consumer welfare  $W(\tau, \theta)$

$$(2) \quad G = \sum_{i \in L} C_i(\tau, \theta) + aW(\tau, \theta),$$

where the coefficient  $a$  captures the trade-off between contributions and total consumer welfare as perceived by the government. Total consumer welfare consists of the sum of total labor income, total profits, net government revenue, total consumer surplus, and the total utility derived from environmental quality. Thus

$$(3) \quad W(\tau, \theta) \equiv l + \sum_{i=1}^n \Pi_i(p_i^s) + Nr(\tau, \theta) + Ns(p^d) + Nu_E(E) \\ = l + \sum_{i=1}^n \Pi_i(p_i^s) + Nr(\tau, \theta) + Ns(p^d) + Nu_E((N-1)c_e)$$

In the first stage of the game, each lobby  $i$  chooses its contribution schedule to maximize the (aggregate) net welfare of its members

$$(4) \quad W_i(\tau, \theta) - C_i(\tau, \theta) \equiv l_i + \Pi_i(p_i^s) + [N_i r(\tau, \theta) + N_i s(p^d) + N_i u_E((N-1)c_e)] - C_i(\tau, \theta),$$

where  $N_i$  is the number of people that own factor  $i$  and  $l_i$  is their (aggregate) labor income. Necessary conditions for a subgame-perfect equilibrium, which consists of a set of contribution functions  $\{C_i^0\}_{i \in L}$  and policy vectors  $\tau^0$  and  $\theta^0$ , are<sup>3</sup>

i)  $C_i^0$  is feasible for all  $i \in L$ ,

that is, contribution schedules must not be negative and cannot exceed aggregate income of each lobby;

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<sup>3</sup> See Proposition 1 in Grossman and Helpman (1994) for all necessary and sufficient conditions.

ii)  $(\tau^0, \theta^0)$  maximizes (2),

that is, given the lobbies' contribution schedules, the equilibrium policies must maximize the government's objective function; and

iii)  $(\tau^0, \theta^0)$  maximizes

$$(5) \quad W_i(\tau, \theta) - C_i^0(\tau, \theta) + \sum_{j \in L} C_j^0(\tau, \theta) + aW(\tau, \theta), \text{ for all } i \in L,$$

that is, the equilibrium policies must maximize the sum of any lobby  $i$ 's net welfare and the government's objective function, given the payments of all other lobbies.

If condition (iii) was violated for any lobby  $i$ , it could modify its contribution schedule so that the government selected a more favorable policy vector and the surplus from such a switch could be shared by the lobby and the government. Thus, a policy that violates (iii) could not have been an equilibrium.

As in Grossman and Helpman (1994), assume that the equilibrium is interior and that contribution schedules are differentiable around the equilibrium point. Taking the first-order conditions for (2) and (5), and combining terms yields

$$(6) \quad \nabla_{\beta} C_i^0(\tau^0, \theta^0) = \nabla_{\beta} W_i(\tau^0, \theta^0), \text{ for } \beta = \tau, \theta \text{ and for all } i \in L.$$

The operator  $\nabla$  denotes the gradient vector of the partial derivative with respect to the  $\beta$ .

Equation (6) requires that the marginal change in payments to the government for a small change in the policy vector has to equal the marginal change in lobby  $i$ 's gross welfare. In other words, the shapes of the contribution schedules reveal the lobbies' true

preferences around the equilibrium point; the contribution schedules are *locally truthful*.<sup>4</sup> In particular, since  $E$  enters the individual utility functions of members of any lobby, the effects of a change in the policy variables  $\tau$  and  $\theta$  on the quality of the environment are taken into account by all lobbies.

Summing equation (6) over the lobbies and substituting into the first-order condition of the government's objective function (2) yields

$$(7) \quad \sum_{i \in L} \nabla_{\beta} W_i(\tau^0, \theta^0) + \alpha \nabla_{\beta} W(\tau^0, \theta^0) = 0.$$

Equation (7) is the first-order condition for maximizing the sum of the lobbies' net welfare and the government's objective. Using equations (1), (3) and (4), together with Hotelling's and Roy's rules, then collecting terms, the first-order conditions (7) for the equilibrium interventions in industry  $i$  are

$$(8a) \quad (\tau_i - 1) = -\frac{(\theta_i - 1)}{\theta_i} \frac{u'_E E'}{p_i^s} = -\frac{(\theta_i - 1)}{\theta_i} \delta \frac{u'_E (N - 1)}{p_i^s}$$

$$(8b) \quad (\theta_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^w M_i'} - (\tau_i - 1) \frac{p_i^d D_i'}{p_i^w M_i'} - \delta \frac{\tau_i D_i' u'_E (N - 1)}{p_i^w M_i'}$$

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<sup>4</sup> Local truthfulness suffices to characterize the structure of protection. Since this game in principle has multiple Nash-equilibria, one has to be selected to determine lobbies' payments in equilibrium. Grossman and Helpman (1994) choose the truthful equilibrium, in which contribution schedules correctly reflect the lobbies' preferences globally, not just around the equilibrium point. In the truthful equilibrium, each lobby pays to the government for any policy vector  $(\tau, \theta)$  the excess of lobby  $i$ 's gross welfare at  $(\tau, \theta)$  relative to some base level of welfare (Grossman and Helpman 1994, p. 840). A truthful equilibrium may be focal among the set of Nash equilibria for two reasons: (1) it is coalition-proof, that is it is stable to nonbinding communication among the lobbies, and (2) it is efficient for the strategic players, that is, given the available policy instruments no feasible Pareto superior outcome exists for the government and the organized interest groups (for discussion, see Bernheim and Whinston, for quasilinear preference, and Dixit, Grossman and Helpman, for more general preferences). In the Grossman-Helpman political economy model, since total welfare appears in the government's objective function, efficient choices are made at the truthful equilibrium not just for the strategic players but for the entire polity (see Corollary 2 to proposition 5 in Dixit, Grossman and Helpman).

where  $M'_i = \tau_i D'_i - X'_i < 0$  is the derivative of domestic import demand, and

$\alpha_L = \sum_{i \in L} \frac{N_i}{N} \leq 1$  is the exogenous share of the population that owns specific factors in

organized industries. The  $\delta$  and  $I_{iL}$  are indicator variables:  $\delta=1$  if consumption creates an externality, that is for  $i=e$ , and  $\delta=0$  otherwise;  $I_{iL}=1$  if industry  $i$  is organized and  $I_{iL}=0$  otherwise.

The system of equations (8) simultaneously determines the political equilibrium domestic and trade policies for industry  $i$

$$(9a) \quad (\tau_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^s X'_i} - \frac{u'_E E'}{p_i^s} = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{1}{\varepsilon_{X_i, p_i^s}} - \delta \frac{u'_E (N-1)}{p_i^s}$$

$$(9b) \quad (\theta_i - 1) = \frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^w X'_i},$$

where  $\varepsilon_{X_i, p_i^s}$  is the elasticity of domestic output supply.

When consumption and trade policies are both available to the government, the political equilibrium for each good involves the use of two policy interventions (whether or not the good generates a consumption externality). In a small open economy, consumption policies cannot affect domestic producer prices. Thus, trade policy is applied to satisfy organized interest groups. The equilibrium trade policy (9b) has only a *political support* term, and will be a favorable import tariff or export subsidy if the industry is organized. The equilibrium trade policy will be an unfavorable import subsidy or export tax if the industry is not organized.

For goods that do not generate an externality, the effect of the trade policy on the domestic producer price will be exactly offset by the equilibrium consumption policy



(other than having opposite signs, the expressions for the political support terms in (9a) and (9b) differ only because the ad valorem policies are expressed in relation to different base prices). Thus, when there is no externality, domestic consumer prices are restored to world levels. The political equilibrium consumption policy is applied to eliminate deadweight consumer surplus losses that would otherwise result from the equilibrium trade interventions.

The political equilibrium consumption policy for any good  $e$  which generates an externality decomposes into a political support effect, the first term on the RHS of (9a), and an additional *environmental effect* (the second term). The environmental effect captures the social costs of an additional unit of consumption of good  $e$ , and requires a consumption tax. It coincides with the standard Pigouvian tax when the political support effect is zero. Thus, the standard Pigouvian tax can be obtained as the political equilibrium policy when either the government weighs total welfare infinitely high ( $a \rightarrow \infty$ ), the entire economy is organized ( $\alpha_L = 1 = I_{ii} \forall i$ ), nobody is organized ( $\alpha_L = 0 = I_{ii} \forall i$ ), or the elasticity of domestic output supply is infinite ( $\varepsilon_{x_e, p_e^*} \rightarrow \infty$ ).

Aside from these extreme cases, the political support effect on trade policy, and hence on protection for an organized industry, is inversely related to  $a$ , also to  $\alpha_L$ , since members of all other organized industries (as consumers) will bid against protection of any given sector, and finally to  $\varepsilon_{x_e, p_e^*}$  reflecting the deadweight loss associated with the interventions (Ramsey pricing). Whether the political equilibrium consumption policy for good  $e$  is a subsidy ( $\tau_e - 1 < 0$ ) or a tax ( $\tau_e - 1 > 0$ ) depends on the signs and relative magnitudes of the political support and environmental effects. When industry  $e$  is

organized, the political support effect requires a subsidy, which will be counterbalanced by an environmental tax to determine the net policy outcome. When industry  $e$  is not organized, the political support and environmental effects have the same sign, both calling for a consumption tax.

Taking the effects of the government's trade and consumption policies together, the domestic consumer price always *differs* from the world price by the Pigouvian tax. Thus, for a small open economy, the political equilibrium policies in the presence of a consumption externality lead to the same domestic consumer prices, and hence to the same level of the externality, as the results from a standard normative analysis. In the political equilibrium, however, organized domestic industries are protected, and more of their outputs are produced within the country than is optimal in a normative model.

Now consider the case when only consumption policy is available to the government of a small open economy. In this case, the government has no instrument to address the special interests of industry lobbies. Setting the ad valorem trade policy equal to one in equation (8a), the equilibrium consumption policy when there is an externality is just the Pigouvian tax.<sup>5</sup>

Setting the ad valorem consumption policy equal to one in equation (8b) yields the equilibrium interventions when the government is limited to the use of trade policy

$$(10) \quad (\theta_i - 1) = -\frac{(I_{LL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^w M_i'} - \delta \frac{D_i' u_E' E'}{p_i^w M_i'}$$

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<sup>5</sup> Pigouvian taxes are not the equilibrium policies for a closed economy in which the government has only consumption policy available. In a closed economy, consumption policies affect producer prices. It can be shown that the political equilibrium consumption policies have the same structure as equation (9a). The equilibrium levels of intervention, however, are generally different than for a small open economy since there are no offsetting tariffs for the closed economy and the expressions are evaluated at different points.

The first term on the RHS of (10) is the political support effect. It is identical to the equilibrium policy expression derived by Grossman and Helpman (1994), and requires an import tariff or an export subsidy when an industry is organized and an import subsidy or an export tax if it is not organized (for the remainder of the paper, the discussion will focus on the outcomes for the organized industries).

When only trade policies are available, the political support term in equation (10) differs from the political support term in the equilibrium trade policy equation (9b), for the case when both consumption and trade policies are available to the government. The difference arises because the Grossman-Helpman political support effect has consumption and production impacts, and therefore depends on the slope of domestic import demand. The political support effect in equation (9b) reflects only production impacts, and depends on the slope of just domestic supply. Thus, the Grossman-Helpman political equilibrium results are a special case that rests on the assumption that the government can only use trade policy.<sup>6</sup>

The equilibrium intervention also includes an additional environmental effect when only trade policy is available to the government and there is an externality. The environmental effect calls for an import tariff or an export subsidy, since either reduces domestic consumption of good  $e$ . Thus, the political support and environmental effects reinforce each other for organized industries.<sup>7</sup>

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<sup>6</sup> See Dixit and Schleich and Orden for further discussion of multiple policy instruments in the Grossman-Helpman model.

<sup>7</sup> The formal result supports the potential observation that industries will claim protection in the name of maintaining the quality of the environment, although such “claims” play no role in the model herein. VanGrasstek (1992) provides empirical support that politicians are willing to implement protectionist trade policies in the name of environmental protection.

### III. PRODUCTION EXTERNALITY

Suppose that the production of nonnumeraire good  $e$  generates an externality such that  $\frac{\partial E}{\partial X_e} = E' > 0$ . Again, assume that the externality negatively affects the well-being of all consumers, so  $u'_E < 0$ .

As before, individual consumers make their consumption decisions taking  $E$  as given. When lobbies set their contribution schedules, they again take into account how the government's interventions affect their members' welfare through impacts on  $E$ .

Now, assume the government can impose *ad valorem* production policies  $\tau_i$  and trade policies  $\theta_i$  on any of the nonnumeraire goods. The production policies drive a wedge between the prices domestic producers and consumers face, and the trade policies separate domestic consumer and world prices. Supply and demand price equilibria for good  $i$  require  $p_i^s = \frac{\theta_i}{\tau_i} p_i^w$  and  $p_i^d = \theta_i p_i^w$  respectively. A production tax implies  $\tau_i > 1$ , while a production subsidy requires  $\tau_i < 1$ . An import tariff or an export subsidy implies  $\theta_i > 1$ , while an import subsidy or an export tax requires  $\theta_i < 1$ . The net per-capita transfer by the government is

$$(11) \quad r(\tau, \theta) = \frac{1}{N} \sum_{i=1}^n p_i^s (\tau_i - 1) X_i(p_i^s) + \frac{1}{N} \sum_{i=1}^n p_i^w (\theta_i - 1) [D_i(p_i^d) - X_i(p_i^s)].$$

Using the same approach as before, the first-order conditions for the equilibrium interventions in industry  $i$  are

$$(12a) \quad (\tau_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^s X_i'} + (\theta_i - 1) \frac{p_i^w}{p_i^s} - \delta \frac{Nu'_E E'}{p_i^s}$$

$$(12b) \quad (\theta_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{\tau_i p_i^w M_i'} - (\tau_i - 1) \frac{p_i^s X_i'}{\tau_i p_i^w M_i'} - \delta \frac{Nu'_E E' X_i'}{\tau_i p_i^w M_i'}$$

where now the derivative of domestic import demand is  $M_i' = D_i' - X_i'/\tau_i$ .

The two first-order conditions (12) simultaneously determine the political equilibrium production and trade policies for industry  $i$

$$(13a) \quad (\tau_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^s X_i'} - \delta \frac{Nu'_E E'}{p_i^s} = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{1}{\varepsilon_{X_i, p_i^s}} - \delta \frac{Nu'_E E'}{p_i^s}$$

$$(13b) \quad (\theta_i - 1) = 0.$$

In the political equilibrium, it is not optimal for the government to apply trade policies when production policies are available. Production policies are more efficient than trade policies for addressing both organized industries' interests and the production externality because trade policies also distort consumption. Equations (13a) and (13b) demonstrate again (very clearly) that the original Grossman-Helpman (1994) results for the equilibrium trade interventions are a special case that depends on the restriction that only trade policy is available to the government.

If an industry is organized, the political support effect in equation (13a) is negative and requires a production subsidy. The political support effect in equation (13a) is the same as the political support effect on consumption policy in equation (9a). For a small open economy, a production subsidy alone, or trade protection (import tariff or export subsidy) together with a consumption subsidy, result in the same equilibrium

domestic producer and consumer price levels for all goods that do not create an externality.<sup>8</sup>

When there is a production externality, the second term on the RHS of (13a) captures an additional environmental effect. It is positive, requiring a production tax, and--without the minus sign--reflects the negative social effects of an additional unit of production. When industry  $e$  is organized, whether the political equilibrium production policy is a subsidy ( $\tau_e - 1 < 0$ ) or a tax ( $\tau_e - 1 > 0$ ) depends on the magnitudes of the political support and environmental effects. When the political support effect is zero, the production policy consists only of the environmental effect, which then coincides with the standard Pigouvian tax for a production externality.

The results for the case where the government has only production policy available are derived by setting the ad valorem trade policy in equation (12a) equal to one. In this case, political equilibrium production policy is the same as in the case where the government could also have chosen trade policy.<sup>9</sup>

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<sup>8</sup> More generally, as discussed by Schleich and Orden, without externalities any two policies are a perfect substitute for the third. It is straightforward to show that similar results hold when there is a consumption or production externality. Thus, when good  $e$  causes a consumption externality, and when for some reason the government is unable to apply consumption and trade policies, it can achieve the same outcome using a combination of production and trade policies. Analogously, for a production externality the political equilibrium combination of consumption and trade policies leads to the same domestic prices as production policy alone.

<sup>9</sup> For a closed economy, it can be shown that the political equilibrium production policy has the same structure as equation (13a). Again, the equilibrium levels of intervention will generally be different for the closed and open economies.

Setting the ad valorem production policy in equation (12b) equal to one yields the political equilibrium when only trade policy is available

$$(14) \quad (\theta_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^w M_i} - \delta \frac{Nu'_E E' X'_i}{p_i^w M_i}.$$

The first term on the RHS of (14) is the political support effect. Again, it is identical to the Grossman-Helpman (1994) equilibrium policy and implies an import tariff or an export subsidy when an industry is organized. For an industry creating an externality, the additional environmental effect requires either an import subsidy or an export tax, since these latter policies reduce domestic production and the externality.

An interesting question in the context of choice among policies when there is a production externality is whether the exclusive use of either production policy or trade policy alone leads to higher prices for organized domestic producers, and thus to lower environmental quality. On one hand, without the externality Schleich and Orden have shown that a production policy leads to a higher equilibrium output price than a trade policy because satisfying the special interest of a particular lobby comes at less cost (no consumption distortion) to the other lobbies and total welfare. On the other hand, if there was no political support effect, because of the consumption distortion associated with the trade policy, a Pigouvian production tax would lead to a lower producer price than a second-best import subsidy or export tax.

Combining the two arguments, no general conclusion can be drawn as to whether the sole use of production policy leads to a higher or lower domestic producer price than the sole use of trade policy when there is a production externality. In particular, it is possible either that trade policy leads to higher protection for the domestic industry than

production policy, or that production policy alone protects the environment less than trade policy.

Using equations (13a) and (14), together with the price equilibrium conditions, trade policy alone leads to the same domestic producer price as production policy alone

when  $-\frac{(1-\alpha_L)X_e}{(a+\alpha_L)p_e^s X'_e} = \frac{Nu'_e E'}{p_e^s}$ . Thus, only when the political support effect exactly

equals the environmental effect--which implies that the equilibrium production and trade policies alone are zero--are the outcomes the same. Production policy leads to a lower producer price and more environmental protection than trade policy only when the environmental effect is large compared to the political support effect.<sup>10</sup>

#### IV. CONCLUSION

This paper characterizes the structure of industry protection and environmental policy for a small open economy when the political equilibrium is derived as the outcome of a noncooperative common agency game between organized industry lobbies and the government. Extending the model proposed by Grossman and Helpman (1994), the political equilibrium policies are composed of a political support effect and, when externalities are associated with the consumption or production of one or more goods, an additional environmental effect. Whether these two effects reinforce or counterbalance

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<sup>10</sup> For a consumption externality, there is a similar ambiguity: trade policy unambiguously leads to more protection of an organized industry than consumption policy, but an import tariff or an export subsidy can lead to higher or lower environmental protection than the Pigouvian consumption tax.



each other generally depends on the nature of the externality, whether the industry is organized, and whether the good is exported or imported.

For the case of a consumption externality, when domestic and trade policies are available to the government, the political equilibrium results in production-enhancing protection of organized industries, but the same level of environmental protection as standard Pigouvian taxes. This is not the case for a production externality because a domestic production policy not only serves the government to address the externality but (unlike the consumption policy) also to satisfy the lobbies. If an organized industry is a polluter, environmental protection is lower than under a standard Pigouvian production tax.

Two important findings of the analysis are that the Grossman-Helpman (1994) political equilibrium results are a special case (resting on the assumption that only trade policy is available to the government), and that it is generally ambiguous whether domestic policy or trade policy *alone* leads to higher or lower environmental protection. The latter result is demonstrated for the case of a production externality. A production subsidy incurs a lower deadweight loss than a trade policy for a given level of support for an organized industry, but a production tax generates a lower deadweight loss than a trade policy for the same level of environmental externality. The relative outcomes from either policy alone for the domestic producer price, production, and the quality of the environment depend on the magnitude of the political support versus environmental impacts.

In evaluating these results, the Grossman-Helpman model and its extension herein may appear restrictive because of the underlying assumptions about production and preferences. However, the basic conclusions drawn about the political equilibrium choice of policies and their relative levels will hold for less restrictive specifications of supply and demand behavior. The assumed structures are convenient because they facilitate the derivation of explicit expressions for the equilibrium interventions, but comparable results can be derived for given parameterizations of more general functional forms.

The structure of the model developed herein is also flexible enough to accommodate a variety of modifications to provide further insight into the little-explored political economy of trade and environmental policies. For example, the production externality can be generated by an input instead of an output, and the set of available policies can include input taxes and subsidies. Alternatively, organized environmental groups can compete with organized industries for environmental protection versus higher profits. The political equilibrium policies under this latter scenario will reflect environmental concerns from the impact of the environmental groups, even if the government is concerned only about contributions and not at all about total welfare.

In another dimension, the political equilibrium policies can be analyzed when countries are “large” and have international market power. Similar to Grossman and Helpman (1995), when countries act unilaterally trade policy will generally be used to exploit a country’s ability to affect its terms of trade. Domestic policies also affect the terms of trade when countries are large, which has implications for the equilibrium policy outcome. In particular, as shown by Schleich and Orden, when a country has market

power it can use consumption policy to satisfy organized industries by raising the world price of their outputs. Thus in a large country model, the political equilibrium consumption policy will not be the Pigouvian tax even in the absence of trade policy.

In a large-country model, the environmental externalities can also be assumed to be either local or global. The structure of the equilibrium policies when governments cooperate on trade and/or domestic policies will be of particular interest. Cooperation among governments will parallel Grossman and Helpman's (1995) regime of "trade talks" instead of "trade wars." Under a trade talks scenario, governments take into account the costs their policies impose on each other. An interesting set of results will emerge depending on whether international cooperation includes domestic policies or is limited to only trade policy.

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## LIST OF SYMBOLS

$N$	population size
$l$	total labor supply
$n$	number of nonnumeraire goods
$L$	set of organized industries
$p_i^w$	world price for good $i$
$p_i^s$	output price for good $i$
$p_i^d$	consumption price for good $i$
$\Pi_i$	quasi-rents of to the specific factor in industry $i$
$X_i$	supply of industry $i$
$X_i'$	derivative of supply of good $i$ with respect to output price of good $i$
$c_{ij}$	consumption of good $i$ by individual $j$
$E$	level of environmental externality generated by the consumption of good $e$ by $N-1$ consumers (consumption externality) or by the production of a good $e$ (production externality)
$u_j$	utility of individual $j$
$u_{ij}$	subutility of individual $j$ derived from the consumption of good $i$
$u_{Ej}$	subutility of individual $j$ derived from the externality generated by all other individuals or the production of a good $e$

$u'_E$	derivative of subutility derived from the externality with respect to the level of the externality E
$d_i$	individual demand for good i as a function of the domestic consumer price for good i
$D_i$	total domestic demand for good i
$D'_i$	derivative of total domestic demand for good i with respect to the consumer price of good i
s	individual consumer surplus derived from the consumption of nonnumeraire goods can be expressed as
v	individual's indirect utility
y	individual income
$\tau_i$	ad valorem tax or subsidy on consumption/production of good i
$\theta_i$	ad valorem tax or subsidy on imports or exports of good i
$\tau$	vector of consumption/production taxes and subsidies
$\theta$	vector of import or export taxes and subsidies
r	per-capita transfer of government net revenue
$C_i$	proposed contribution of organized industry i to the government
$W$	total consumer welfare
G	government's welfare
a	parameter that captures the trade-off between contributions and total welfare for the government.
$W_i$	gross welfare of all members of lobby i



$l_i$	total labor supply of all members of lobby i
$\nabla$	gradient vector of the partial derivative with respect to domestic and trade policies
$M'_i$	derivative of domestic import demand for good i with respect to domestic price for good i
$I_{iL}$	indicator variable that takes on the value of 1 if industry i is organized and zero if the industry is not organized
$\delta$	indicator variable that takes on the value of 1 if the consumption or production of good i generates an environmental externality, and a value of 0 otherwise
$\alpha_L$	share of the population that owns specific factors in organized industries
$\varepsilon_{X_e, p_e^e}$	elasticity of domestic output supply of good i with respect to the price of good i