

## CHAPTER 3

### ENDOGENOUS DOMESTIC AND TRADE POLICIES IN A SMALL OPEN ECONOMY WITH PRODUCTION AND CONSUMPTION EXTERNALITIES

#### 3.1. Introduction

Over the last two decades trade and environment policy issues have gained considerable attention. The traditional approach to formal analysis of environmental policy-making is based on Pigou (1932) and views the government as an omniscient benevolent dictator who maximizes social welfare.<sup>34</sup> In this normative framework, interventions are necessary to achieve allocative efficiency in the presence of market failures, such as production or consumption externalities. Pigouvian taxes that are directly linked to the source of the externality emerge as the optimal solution (see Baumol and Oates, 1988, for an overview). Trade policies, such as import tariffs, lead to a deadweight loss and less environmental protection, so they are generally inferior to a more direct intervention, such as effluent fees, or input, output or consumption taxes, depending on the cause of the market failure.

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.” In particular, policy-makers can use environmental policy not only to address environmental externalities but also to influence the international competitiveness of domestic industries. Trade policy can be used to protect domestic industries from foreign competition as well as to affect environmental quality.

These 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 include environmental externalities.<sup>35</sup> For example, Hillman and Ursprung (1992) show how environmental groups affect the chances of liberal versus protectionist trade policy. In this model of *political competition*, candidates accept contributions from interest groups to influence their chances of getting elected. The politicians’ policy stances however are predetermined and unaffected by the lobbies’ contributions. In a more recent study, Bommer (1996) shows that European integration could lead to high-level harmonization of environmental process standards, instead of downward competition of national standards that would provide domestic industries

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<sup>34</sup> See Baumol and Oates (1988) for an overview.

<sup>35</sup> For a recent overview on the political economy of trade policy see Rodrik (1995).

with a competitive advantage. In his model, the policy-maker chooses environmental standards to maximize an (ad hoc) *political-support* function that includes profits of organized industries and a measure of environmental quality that reflects the impact of environmental groups. The political-support function includes fixed weights for the different interest groups and there is no role for political contributions.

The objective of this paper is to analyze the structure of environmental and industry protection in a small-country model when there are production or consumption externalities and the government has domestic and/or trade policies available. In particular, it is explored whether the lobbying of organized industry groups leads to higher or lower environmental quality than is socially desirable. The implications for environmental quality and industry protection are examined when the government has multiple policies at hand. Finally, it is inquired whether a standard result from normative economic theory holds in the political equilibrium: a more direct policy alone always leads to higher environmental quality than trade policy alone.

The analysis presented herein builds on the political economy model developed recently by Grossman and Helpman (1994). In the Grossman-Helpman model, owners of some sector-specific factors are represented by industry lobbies that offer contributions to the government contingent on the levels of its policy decisions. The Grossman-Helpman model is in the spirit of the political-support function approach but derives the government's objective function from first principles, explicitly allowing for contributions. Unlike in the political competition approach, contributions are not primarily aimed at affecting the outcome of elections but rather to influence the government's policy stance. The lobbies' and the government's decisions are modeled as a first-price menu auction in a noncooperative common agency game with perfect 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. Instead of the menu auction, this paper uses a simpler mechanism that yields the same outcomes as the menu-auction: Lobbies and the government are assumed to play a Nash bargaining game.

In this paper, two extensions of the basic Grossman-Helpman model are developed to address trade and environment political economy. First, it is assumed that production or consumption of one (or more) industry outputs generates a negative externality. For simplicity, it is assumed that the environmental externality is generated by the production or consumption 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.

Second, while previous political economic analyses have generally focused on one instrument only, in reality governments often have multiple policies available. In the models presented herein, the governments may have multiple instruments available. The domestic

policies considered are either production or consumption taxes and subsidies, while the trade policies are taxes and subsidies on imports and exports.<sup>36,37</sup>

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.<sup>38</sup> 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 and the externality is (at least partially) internalized.<sup>39</sup>

The remainder of the paper is organized as follows. Section 3.2. develops the methodology and implicitly derives the political equilibrium levels of domestic and trade policies for a small open economy when an externality is generated by production. In particular, it is analyzed whether domestic policy necessarily leads to higher environmental protection than trade policy for a production externality. In section 3.3. the equilibrium policies are derived for a consumption externality. Section 3.4. concludes.

### ***3.2. Production Externality***

The model is based on Grossman and Helpman (1994) but uses a simpler solution concept that leads to exactly the same policy outcomes.

#### ***Consumers***

In the home country, the population of  $N$  residents provide a total labor supply  $l$  and have identical, additively separable quasi-linear preferences defined over  $(n+1)$  goods. 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 the externality  $E$ . All  $u_{ij}(\cdot)$  are assumed to be

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<sup>36</sup> Frederiksson (1997) and Aidt (1997a,b) also use the Grossman-Helpman model to analyze the structure of environmental and industry protection in a small-country model, but they only consider a production externality. While Frederiksson and Aidt (1997a) concentrate on one endogenously derived policy only, that is on production policy, Aidt (1997b) also allows for input taxes/subsidies.

<sup>37</sup> While command-and-control type regulation is still the dominant approach, the role of market-based policies such as "Eco-taxes" has been increasing for political and economic reasons, at least in OECD countries (OECD 1995).

<sup>38</sup> Alternatively, organized environmental groups could be introduced. Incorporating environmental groups would generally lead to higher environmental protection and would also alter industry protection due to terms reflecting he environmental political support effect, but it would not change the basic model structure.

<sup>39</sup> Aidt (1997a,b) also illustrates how externalities can be internalized through competition between organized interest groups in the Grossman-Helpman model. This finding is a natural consequence of the menu auction used to solve the common agency problem as developed by Bernheim and Whinston (1986).

increasing and concave functions, and, for specificity, it is assumed that the externality is negative, that is  $\frac{\partial u_{Ej}}{\partial E} = u'_{Ej} < 0 \quad \forall j$ . Assuming that preferences are identical the subscripts for consumers can be dropped.

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. Individual indirect utility can be expressed as  $v(p^d, y, E) = y + s(p^d) + u_E(E)$  where  $p^d = (p_1^d, p_2^d, \dots, p_n^d)$  is the vector of consumer prices for non-numeraire goods,  $y$  represents her income, and  $s(p^d) = \sum_{i=1}^n u_i[d_i(p_i^d)] - \sum_{i=1}^n p_i^d d_i(p_i^d)$  is consumer surplus from all non-numeraire goods. Individual demands are  $d_i(p_i^d) = -\frac{\partial s}{\partial p_i^d}$ , and total demand for any good  $i$  in the home country is  $D_i(p_i^d) = N d_i(p_i^d)$ , with  $\frac{\partial D_i}{\partial p_i^d} = D'_i \leq 0$ .

### ***Producers***

All sectors produce under perfect competition. The numeraire good is made from labor alone, such that one unit of labor produces one unit of output. Since the domestic and world prices of the numeraire good are equal to one, the economy wide wage rate is fixed at unity. All other goods are produced from labor and one perfectly inelastically supplied specific input, with constant returns to scale in both factors but diminishing returns in individual factors. This production structure leads to (aggregate) quasi-rents of  $\Pi_i(p_i^s)$  to the fixed factor in industry  $i$  that only depend on the output price received by producers  $p_i^s$ . Supply is given by

$$X_i(p_i^s) = \Pi'_i(p_i^s), \text{ with } \frac{\partial X_i}{\partial p_i^s} = X'_i > 0 \text{ and } \frac{\partial^2 X_i}{\partial p_i^{s2}} \leq 0.$$

Suppose that the production of one or more non-numeraire goods  $e$  generates an externality  $E$  such that  $\frac{\partial E(X_e)}{\partial X_e} = E' > 0$  and  $\frac{\partial E^2(X_e)}{\partial X_e^2} = 0$ . The externality has no impact on the production process of any other good, but instead it negatively affects the well-being of consumers.

## **Lobbies**

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 is assumed to organize themselves in order to affect government policies using contributions. When lobbies choose their contributions they take into account how the government's interventions affect their members' welfare through impacts on  $E$ . Each lobby  $i$  chooses its contributions to maximize the (aggregate) net welfare of its members (= gross welfare  $W_i$  minus contributions  $C_i$ )

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

where  $\tau$  stands for the vector of production policies and  $\theta$  stands for the vector of trade policies.  $N_i$  is the number of people that own factor  $i$ ,  $l_i$  is their (aggregate) labor income and  $r$  is the per-capita transfer from any government revenue.

## **Government**

The government is assumed to maximize a weighted sum of contributions from organized industries and total consumer welfare

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

where the coefficient  $a$  captures the trade-off between contributions and total consumer welfare as perceived by the government.<sup>40</sup> 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

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

The government uses the contributions for its reelection campaign or for its own private consumption. It is concerned about total welfare because consumer well-being influences its chances for reelection or for (unspecified) ethical reasons. To achieve its objectives, the home government can impose *ad valorem* production policies  $\tau_i$  and/or trade policies  $\theta_i$  on any of the non-numeraire goods. The production policies drive a wedge between the prices that consumers

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<sup>40</sup> See Grossman and Helpman (1996) for an endogenous derivation of this objective function.

and producers face, and the trade policies separate domestic producer and world (or offshore) prices  $p_i^w$ . Supply and demand price equilibria for good  $i$  require  $p_i^s = \frac{\theta_i}{\tau_i} p_i^w$  and  $p_i^d = \theta_i p_i^w$ .

The net revenue of the government (excluding contributions by lobbies) is generated by its domestic and trade policies. 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 net per-capita transfer by the government is

$$(4) \quad r(\tau, \theta) = \frac{1}{N} \sum_{i=1}^n p_i^s (\tau_i - 1) X_i(p_i^s) + \frac{1}{N} \sum_{i=1}^n p_i^w (\theta_i - 1) [D_i(p_i^d) - X_i(p_i^s)].$$

Contributions received by the government from organized interest groups are not part of the per-capita transfer (4) and 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.

### ***Solution Concept***

Grossman and Helpman (1994) base their analysis on Bernheim and Whinston (1986) who model the lobbies' and government's behavior as a first-price menu-auction in a common agency game with perfect information.<sup>41</sup> In this paper, organized industries and the government are assumed to engage in a Nash bargaining game which yields the same outcomes for the policies as the menu-auction.<sup>42</sup> The efficiency-property of the Nash bargaining solution requires that the equilibrium policies maximize the joint surplus of the active players

$$(5) \quad \Omega = aW(\tau, \theta) + \sum_{i \in L} W_i(\tau, \theta).$$

The first-order conditions for the equilibrium interventions in industry  $i$  are

$$(6a) \quad (\tau_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^s X_i'} + (\theta_i - 1) \frac{p_i^w}{p_i^s} - \frac{Nu'_E E'}{p_i^s}$$

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<sup>41</sup> The government is the common agent whose actions are the policies, while each lobby is a principal whose bids are its contributions. In the first stage of the two-stage noncooperative game, lobbies simultaneously and noncooperatively set their contribution schedules which map each policy vector into a nonnegative contribution level. In the second stage, the government chooses its policies given the contribution schedules. Expressions for the equilibrium levels of policy interventions are derived assuming that the contribution schedules are differentiable around the equilibrium point, and that the equilibrium is interior.

<sup>42</sup> Goldberg and Maggi (1997) use the same solution mechanism.

$$(6b) \quad (\theta_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{\tau_i p_i^w M_i'} - (\tau_i - 1) \frac{p_i^s X_i'}{\tau_i p_i^w M_i'} - \frac{Nu'_E E' X_i'}{\tau_i p_i^w M_i'},$$

where  $M_i' = D_i' - \frac{X_i'}{\tau_i}$  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.  $I_{iL}$  is an indicator variable with  $I_{iL}=1$  if industry  $i$  is organized and  $I_{iL}=0$  otherwise. The system of equations (6) implicitly determines the political equilibrium production and trade policies for industry  $i$

$$(7a) \quad (\tau_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^s X_i'} - \frac{Nu'_E E'}{p_i^s} = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{1}{\varepsilon_{X_i, p_i^s}} - \frac{Nu'_E E'}{p_i^s}$$

$$(7b) \quad (\theta_i - 1) = 0,$$

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

In the political equilibrium, it is not optimal for the government to apply trade policies when production policies are also 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. This result illustrates that a political economy version of Bhagwati's (1971) targeting principle applies to the Grossman-Helpman model. Thus, the original Grossman-Helpman (1994) result for the equilibrium trade intervention is a special case that rests on the assumption that only trade policy is available to the government.<sup>43</sup>

The equilibrium production policy consists of a *political support* term, that will be an output subsidy (tax) if the industry is organized (not organized), and an additional *environmental effect* that requires an output tax if production of the good causes an externality. This environmental effect captures the social costs of an additional unit of production.<sup>44</sup> The standard Pigouvian tax emerges as a special case when the political support effect vanishes, that is when either the government weighs total welfare infinitely high ( $a \rightarrow \infty$ ), the entire economy is organized ( $\alpha_L = 1 = I_{iL} \forall i$ ), nobody is organized ( $\alpha_L = 0 = I_{iL} \forall i$ ), or the elasticity of domestic output supply is infinite ( $\varepsilon_{X_i, p_i^s} \rightarrow \infty$ ).

<sup>43</sup> Dixit (1996) comes to the same conclusion considering production taxes/subsidies together with consumption taxes/subsidies. Aidt (1997b) confirms that the targeting principle also holds when the government uses production and input policies to address a production externality and to satisfy industry (and environmental) lobbies.

<sup>44</sup> For the remainder of the paper, the interpretation of the equilibrium policies is limited to the case where the industries are organized.

From an environmental standpoint, the question arises of what impact the lobbying activity of organized industry groups has on environmental quality. Since equation (7a) gives the political equilibrium policy only implicitly, no general conclusion can be drawn. However, under more specific assumptions, the question can be answered.

**Proposition 1.**

If the industry that causes the production externality is organized and  $\frac{\partial^2 u_E}{\partial E^2} = u''_E \leq 0$  holds, then environmental quality in the political equilibrium is lower than under the Pigouvian tax.<sup>45</sup>

**Proof.**

Rewrite equation (7a) as

$$(7aa) \quad (p_i^s - p_i^w) = \frac{(I_{iL} - \alpha_L) X_i}{(a + \alpha_L) X'_i} + Nu'_E E'$$

and consider the following cases:

*Case a)*  $u''_E = 0$ , which implies that the environmental effect ( $Nu'_E E'$ ) is constant. Since the political support effect in equation (7aa) is positive for an organized industry,  $p_i^s$  in the political equilibrium is higher and environmental quality is lower than under the Pigouvian tax.

*Case b)*  $u''_E < 0$ . Suppose  $p_i^s$  in the political equilibrium is lower than under the Pigouvian tax. Since the political support effect is positive, the environmental effect has to decrease compared to the scenario under the Pigouvian tax. But when  $p_i^s$  is lower than under the Pigouvian tax, the environmental effect is higher since  $u''_E < 0$ , a contradiction. Q.E.D

In general, environmental quality will be lower than socially optimal due to the actions of an organized polluting industry when the marginal disutility from the externality does not decrease too fast in  $p_i^s$ . In other words, unless the marginal costs (in terms of reduced environmental quality) are decreasing rapidly, environmental quality in the political equilibrium will be lower than under the Pigouvian tax. For  $u''_E > 0$ , it is possible that the political equilibrium leads to higher environmental quality than the Pigouvian tax (provided the second-order condition for the maximization problem holds).

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<sup>45</sup> See also Aidt (1997a,b) and Fredriksson (1997) who only consider a constant environmental effect.

Now consider the cases when the government is restricted to only one type of policy. Naturally, the result for the case where the government has only production policy available is the same as in the case where the government could also have chosen trade policy.<sup>46</sup> Setting the ad valorem production policy in equation (6b) equal to one implicitly yields the political equilibrium when only trade policy is available

$$(8) \quad (\theta_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^w M_i'} - \frac{Nu'_E E' X_i'}{p_i^w M_i'}$$

The first term on the RHS of (8) is the political support effect and implies an import tariff or an export subsidy. This political support effect is just the original result derived by Grossman and Helpman (1994) when there is no externality and the government is restricted to trade policy. For an industry causing 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.

### ***Environmental Quality with Production Policy or Trade Policy***

A standard result of normative economic policy-making is that when a welfare-maximizing policy-maker has either only production policies or only trade policies available, the production policy will lead to higher environmental quality than the trade policy. This is because, to achieve the same level of environmental quality, the trade instrument leads to distortions on the consumption side of the economy. An interesting question is whether the result still holds when policies are determined endogenously.

#### **Proposition 2.**

Trade policy alone can lead to higher environmental quality than production policy alone.

#### **Proof (by example).**

Suppose  $X_i = kp_i^s$ ,  $E = bX_i$ , with  $k, b > 0$ , and  $u = c_0 + Ac_i - \frac{1}{2}c_i^2 + \sum_{j=1, j \neq i}^n u_j(c_j) - E$ .

Import demand for good  $i$  is then  $M_i = A - p_i^d - kp_i^s$ . Further assume that the polluting industry is organized, that is  $I_{iL}=1$ . Using equation (7a) the producer price for the case when only production policy is available can be derived as

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<sup>46</sup> For a closed economy, it can be shown that the political equilibrium production policy has the same structure as equation (7a). However, the equilibrium levels of intervention will generally be different for the closed and open economies.

$p_i^{s\tau} = \frac{(a + \alpha_L)[p_i^w - Nb]}{(a + 2\alpha_L - 1)}$ . The denominator is positive from the second order condition

to the maximization problem. Also assume that  $p_i^w > Nb$ , or else there would be no production in industry i. From equation (8) the producer price for the case when only

trade policies are available is  $p_i^{s\theta} = \frac{(a + \alpha_L)[p_i^w + k(p_i^w - Nb)]}{(a + \alpha_L) + k(a + 2\alpha_L - 1)}$ . Now,

$p_i^{s\tau} > p_i^{s\theta} \Leftrightarrow (p_i^w - Nb)(a + \alpha_L) > p_i^w(2\alpha_L + a - 1)$ , where all expressions are nonnegative. Thus, depending on the parameter values, it is possible that  $p_i^{s\tau} > p_i^{s\theta}$ , that is trade policy alone can lead to higher environmental quality than production policy alone. Q.E.D.

The intuition behind Proposition 2 is as follows. On one hand, without the externality the production policy leads to a higher equilibrium output price (and a higher output level) than the 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. In the example, for  $b=0$ , it is always true that  $p_i^{s\tau} > p_i^{s\theta}$  as long as  $\alpha_L < 1$ .<sup>47</sup> 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 (and a lower output level) than an import subsidy or an export tax. For example, if  $\alpha_L = 1 = I_{iL}$ , then

$$(p_i^w - Nb)(a + 1) < p_i^w(a + 1) \Rightarrow p_i^{s\tau} < p_i^{s\theta}.^{48}$$

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 that trade policy alone leads to higher environmental quality than production policy alone.<sup>49</sup>

<sup>47</sup> If  $\alpha_L = 1$  everybody in the economy is organized. This case illustrates that, if there was no externality there would be no intervention and  $\tau_i = \theta_i = 1$ .

<sup>48</sup> Similarly, for  $\alpha_L = 0 = I_{iL}$ ,  $(p_i^w - Nb)a < p_i^w a \Rightarrow p_i^{s\tau} < p_i^{s\theta}$ . Using the rule of l'Hôpital, it can be shown that  $\lim_{a \rightarrow \infty} \frac{(a + \alpha_L)(p_i^w - Nb)}{p_i^w(2\alpha_L + a - 1)} = \frac{(p_i^w - Nb)}{p_i^w} < 1 \Rightarrow p_i^{s\tau} < p_i^{s\theta}$ . Likewise,  $\lim_{k \rightarrow \infty} p_i^{s\tau} = \lim_{k \rightarrow \infty} p_i^{s\theta} = \frac{(a + \alpha_L)(p_i^w - Nb)}{(2\alpha_L + a - 1)} = p_i^{s\tau}$ .

<sup>49</sup> An alternative paradox could be stated in terms of industry protection as measured by the level of the output price. Since there is a direct inverse relationship between environmental and industry protection, the example above also demonstrates that when there is a production externality, trade policy can lead to higher industry protection than production policy.

The question then arises what determines whether trade policy alone leads to higher environmental quality than production policy alone or vice versa. The example above indicates that trade policy will lead to higher environmental quality than production policy when  $b$  is small. In general, if an additional unit of output only leads to a small decrease in the utility derived from environmental quality, then the government can increase producer price (and output) to satisfy the organized polluting industry at low cost. Using production policy, this increase will be greater than using trade policy since trade policy also distorts consumption. Hence, environmental quality will be higher using trade policy than using production policy when the effect of an additional unit of production on the utility derived from environmental quality is small. The other determinant of whether trade policy alone leads to higher environmental quality than production policy alone is the political strength of the organized polluting industry as measured by the political support effect. An increase in the political strength (for example, through a decrease in  $a$ , the relative weight the government attaches to total welfare, or a decrease in  $\alpha_L$ , the degree of organization in the economy) will trigger a greater increase in the output price when the government uses production policy rather than trade policy, since the latter also distorts consumption. Thus, when the polluting industry is politically strong, environmental quality will be higher when the government uses trade policies instead of production policies. Depending on the magnitudes of political support and environmental effects, it is possible, that the political equilibrium trade policy is closer to the socially optimal Pigouvian tax than the production policy.<sup>50</sup>

Trade policy alone leads to the same domestic producer price as production policy alone only when the political support effect exactly equals the environmental effect, that is

$$-\frac{(1 - \alpha_L) X_i}{(a + \alpha_L) p_i^s X_i'} = \frac{Nu_i' E'}{p_i^s}.$$

Using equations (7a) and (8), together with the price equilibrium conditions, establishes this result. Thus, only when the equilibrium production and trade policies alone are zero--are the outcomes the same.

### 3.3. Consumption Externality

Suppose that consumption of a non-numeraire good generates a negative externality. For simplicity assume that for each individual  $j$ , the externality is just  $E = \sum_{\substack{k=1 \\ k \neq j}}^N c_{ek}$ . When an

individual decides on her level of consumption of a good, she does not take into account the effects of her decision on any other individual's utility.<sup>51</sup> Thus,  $E = (N-1)c_e$ , with  $\frac{\partial E}{\partial c_e} = (N - 1)$ .

<sup>50</sup> Note that when (P1) of Proposition 1 is satisfied, and the trade policy leads to higher environmental protection than the production policy, then the trade policy is closer to the Pigouvian tax than the production policy.

<sup>51</sup> Assuming that  $N$  is sufficiently large justifies this assumption.

Now the government is assumed to have consumption taxes/subsidies together with trade policies available. The price equilibria for good  $i$  are now  $p_i^s = \theta_i p_i^w$  and  $p_i^d = \theta_i \tau_i p_i^w$  respectively and the net per-capita transfer by the government is

$$(9) \quad r(\tau, \theta) = \frac{1}{N} \sum_{i=1}^n p_i^s (\tau_i - 1) D_i(p_i^d) + \frac{1}{N} \sum_{i=1}^n p_i^w (\theta_i - 1) [D_i(p_i^d) - X_i(p_i^s)].$$

The first-order conditions for the consumption and trade policies are

$$(10a) \quad (\tau_i - 1) = -\frac{(\theta_i - 1)}{\theta_i} - \frac{u'_E E'}{p_i^s} = -\frac{(\theta_i - 1)}{\theta_i} - \frac{u'_E (N - 1)}{p_i^s}$$

$$(10b) \quad (\theta_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^w M'_i} - (\tau_i - 1) \frac{p_i^d D'_i}{p_i^w M'_i} - \frac{\tau_i D'_i u'_E (N - 1)}{p_i^w M'_i},$$

where now  $M'_i = \tau_i D'_i - X'_i < 0$ . The system of equations (10) implicitly determines the political equilibrium consumption and trade policies

$$(11a) \quad (\tau_i - 1) = -\frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^s X'_i} - \frac{u'_E (N - 1)}{p_i^s}$$

$$(11b) \quad (\theta_i - 1) = \frac{(I_{iL} - \alpha_L)}{(a + \alpha_L)} \frac{X_i}{p_i^w X'_i}.$$

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). Unlike in the case of the production externality, now the combination of policies always allows the government to achieve the same level of environmental quality as under a Pigouvian tax.

### Proposition 3.

The combination of consumption and trade policies of equations (11a) and (11b) leads to the socially optimal level of environmental quality.

### Proof.

First notice that the Pigouvian tax can be obtained by setting  $\theta_i = 1$  in equation (10a) as

$$-\frac{u'_E (N - 1)}{p_i^s} > 0, \text{ which is just the social costs of an additional unit of consumption.}$$

Thus, the socially optimal price consumers pay is (P2)  $p_i^d = p_i^w - u'_E (N - 1)$ .

Rewriting equations (11a) and (11b) yields

$$(P3) \quad p_i^d - p_i^s = -\frac{(I_{iL} - \alpha_L) X_i}{(a + \alpha_L) X_i'} - u'_E(N - 1)$$

$$(P4) \quad p_i^s - p_i^w = \frac{(I_{iL} - \alpha_L) X_i}{(a + \alpha_L) X_i'}$$

Substituting (P4) into (P3) yields (P2). Q.E.D.

The intuition behind Proposition 3 is as follows. In a small open economy, consumption policies cannot affect domestic producer prices and are not suitable to satisfy the lobbies. Thus, consumption policies alone will lead to the Pigouvian tax and the government has no instrument to satisfy organized industries. If trade policies are also available, equation (11b) implies that they are used to raise producer prices through an import tariff or an export subsidy. The consumption policy is then not only applied to address the externality but--through a subsidy--also to offset the consumption distortion created by the trade policy.<sup>52</sup> 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.<sup>53</sup>

Results for the cases where governments have only one policy available can be obtained setting  $\theta_i = 1$  in equation (10a) or  $\tau_i = 1$  in equation (10b). When only trade policy is available, political support and environmental effects reinforce each other. Similar to the case with a production externality, it is ambiguous whether trade policy alone leads to higher or lower environmental protection than the Pigouvian consumption tax.

### 3.4. Conclusions

This paper characterizes the structure of environmental and industry protection for a small open economy within the Grossman-Helpman framework when the political equilibrium is derived as the outcome of a Nash bargaining game (or of a noncooperative common agency game) between organized industry lobbies and the government. Given the assumed structure of

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<sup>52</sup> Note that without externalities, the combination of consumption subsidies and trade policy yields the same industry protection and resource allocation as the production subsidy from equation (6a). More generally, 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>53</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 policy has the same structure as equation (11a). 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 model, the equilibrium policies can be expressed as the sum of distinct political support and environmental effects.

The results illustrate that Bhagwati's (1971) targeting principle, which was originally developed for a normative framework, also applies to the Grossman-Helpman political economy model: the government uses the most direct policy to address the environmental externality and to satisfy the industry lobbies respectively. In the case of a negative production externality, production taxes that target the externality are counterbalanced by subsidies to please the lobbies. When production policies are available, there is no role for trade policies. Since the political equilibrium policies can only be derived implicitly, no general conclusion can be drawn as to whether the lobbying of organized industry group leads to lower or higher environmental quality. Sufficient conditions are derived for which environmental quality in the political equilibrium is lower than under a Pigouvian tax if the industry that causes the production externality is organized.

An important finding of the analysis is that--in contrast to standard economic theory--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 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.

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 but increased domestic output from the organized polluting industries.

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 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 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, 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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