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POLITICAL INTERNALIZATION
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IN A POLITICO-ECONOMIC MODEL
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Political Internalization of Economic Externalities. The Case of Environmental Policy in a Politico-Economic Model with Lobby Groups

by

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Abstract.

This paper shows how competition between interests can internalize economic externalities groups. The key feature is that some lobby groups give political voice to environmental demands. We illustrate the basic ideas in a common agency model of politics, into which we introduce a negative output externality. We show that the politically optimal structure of environmental taxes incorporates the full Pigouvian adjustment. However, since lobby groups care about the distribution of income as well as about efficiency, the equilibrium structure of taxes differs considerably from the set of Pigouvian taxes. In particular, organized sectors get a tax discount, while unorganized sectors are taxed at an inefficiently high rate. Hence, environmental lobbying has a huge beggar-thy-neighbour element.

Key words: Environmental policy, lobby groups, lobbying, positive environmental economics.
JEL classification: H23, D78 and Q28.

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1. Introduction

Within the last decades, environmental policy has become highly politicised. The driving force behind much of the influence activities surrounding environmental policy is the fact that environmental policy has both efficiency enhancing and income distributional aspects. That is, economic agents (consumers and firms) are motivated to take collective political actions because the adverse effects of emission harm them and/or because they are harmed by the income distributional effects of environmental policy itself.

The main contribution of this paper is to point out that although the political market for environmental policy is highly distorted, the fact that people do organize lobby groups is an important source of internalization of economic externalities. That is, lobby groups give voice to the various aspects of environmental policy and insure that all aspects are considered in the political trade off and reflected in the implemented policy. We distinguish between lobby groups that are functionally specialized and groups that have multiple goals. A functionally specialized lobby group acts as an advocate for only one aspect of environmental policy. Here, the government protects the environment to the extent that the political compromise favours environmental interests over other, say, profit interests. An example in point is the CO_2 duty in Europe. Here, environmentalists seek a high common duty on CO_2 emission, whereas all producer interests seek as low a duty as possible. Some lobby groups, like trade unions and employer associations, advocate multiple goals reflecting the variety of interests that their membership has. Environmental concerns, accordingly, enter the agenda to the extent that environmental issues are of concern to the members. As a consequence, lobby groups modify their demands to reflect environmental concerns *before* they enter the competitive political process, and, opposite to the case of functionally specialized lobby groups, political internalization is not only a product of political competition. An example in point is the Danish Aquatic Environmental Plan (AEP) from 1987 [see, e.g. ATV (1990)]. The AEP is a blue print that specifies how to protect the aquatic environment in Denmark by means of reductions in the emission of nitrogen and phosphor from agriculture, industry and households. In the political game surrounding the design of the plan, the behaviour of at least industry and household lobby groups suggested that they had multiple goals. That is, besides wanting to reduce their share of the total cost of reduction (the beggar-thy-neighbor element of lobbying), these groups voluntarily accepted to reduce emission.

The idea of political internalization of externalities brings together elements of a Coasian [see Coase (1960)] and a Pigouvian [see, e.g. Baumol and Oates (1988)] approach to environmental policy. In line with the Coasian tradition, affected parties mobilize to protect their interests. However, instead of working out a private transfer scheme, they further their goals via political markets, presumably because doing so minimize transaction costs. A self-interested policymaker with coercive power to implement environmental policy (the Pigouvian element) then trades off the demands of the various lobby groups against the general interests of the voters.

To formalize our ideas, we implement the structure of a common agency of politics in a small open economy with n productive sectors as in Helpman and Grossman (1994)[2]. A political distortion arises from the fact that lobby groups offer campaign contributions to an electorally motivated government in exchange for particular political favours. The issue of environmental policy arise because of a production externality. We assume that emission is directly related to output, and that emission is harmful only to consumers. This implies that emission and production taxes-cum-subsidy are equivalent. Clearly, this specification is dubious since it prevents us from asking important environmental questions such as: To what extent do firms substitute to a cleaner technology in response to environmental policy, would the political process prefer production taxes-cum-subsidies to emission taxes and so on? However, the specification does allow us to focus more clearly on the differences between the social optimum and the politically distorted equilibrium. We analyse two specifications of the demand side of the political market. The main body of the paper is concerned with lobby groups that have multiple goals. In particular, we assume that the factor owners in some sectors organize lobby groups to influence environmental policy. We assume that each lobby group represents the preferences of its membership sincerely. Accordingly, besides wanting to protect industry profit, it also cares about environmental protection and transfers via the government budget. To show that the main results generalize to the case of functionally specialised lobby groups, we briefly analyse the case in which some producer lobby groups lobby to protect their profit-interests and an environmentalist lobby group lobby in favour of environmental protection.

[2]The basic common agency model is due to Bernheim and Winston (1986), and it has been applied to trade policy [see Grossman and Helpman (1994, 1995a, 1995b) and Schleich and Orden (1996)], commodity taxation [see Dixit (1995) and Dixit, Helpman and Grossman (1996)] and environmental policy [see Schleich (1997)]. Schleich (1997) analyses the choice between trade instruments and domestic price instruments in context of a consumption externality and a production externality that is related directly to output. Hence, his work is complementary to the work presented in this paper.

In a political equilibrium, we can decompose environmental policy into a term that reflects the usual distributional concerns [as in Dixit (1995) and Helpman and Grossman (1994)] and a term that reflects environmental concerns, the environmental adjustment. If lobby groups have multiple goals, then the environmental adjustment captures the full Pigouvian adjustment. That is, although each lobby group only cares about the well-being of its own membership and not all citizens are organized, the political process *everything else being equal* takes into account the marginal social damage of emission. If lobby groups are functionally specialized, then environmental concerns are over-represented in the political trade off compared with the concern for the distortionary cost of taxation, and, accordingly, the environmental adjustment in the political equilibrium is greater than the Pigouvian adjustment. Due to the lobby groups´ income distributional concerns, the political equilibrium does not replicate the social optimum, and, so, the politically optimal environmental policy, in general, differs from the appropriate Pigouvian taxes. In particular, organized sectors are given a tax discount, i.e. they pay less than the Pigouvian tax. Moreover, if the lobby groups have multiple goals, the government taxes unorganized sectors at an inefficiently high rate. It follows immediately that emission in the political equilibrium is unlikely to be efficient, and that we cannot, in general, say anything about the direction of the inefficiency.

We organize the remainder of the paper as follows. Section 2 sets out the basic model. In sector 3, we consider the normative properties of the model. In section 4, we consider the political equilibrium under the assumption that lobby groups have multiple goals and illustrate the principle of political internalization of an externality. Section 5 considers what we can say about emission. In section 6, we introduce specific functional forms to gain more insight into the nature of the political equilibrium. Section 7 considers the nature of the lobbies' contribution schedule when strategies are linear. In section 8, we consider the case of functionally specialized lobby groups. Section 9 concludes and discusses some interesting extensions of the model.

2. The Model

The economy

We extent the Grossman and Helpman (1994) model with an output externality. That is, we consider a small open economy with an infinitely elastic labour supply, l. There are n+1 competitive sectors of production, k=0,..,n. Good 0 is numeraire. The international prices of the n non-numeraire goods are p^*_k, whereas the domestic producer prices are denoted by p_k and the domestic consumer prices are given by q_k. Production in the numeraire sector takes place by means of a constant return to scale technology using only labour as input. Consequently, profit maximization and mobility of labour across sectors pin down the wage rate of the economy at w=1. There is no emission from this sector. Technology in the remaining n sectors is also CRS. Each sector uses two inputs: Labour and industry specific capital that is in fixed supply. There are no cross effects in supply. So, profit maximization leads to a convex restricted profit function of the type, $\pi^k(p_k)$. The profit is the reward to the specific capital used in sector k. From Hotelling's lemma, we have that supply from sector k is $\pi^k_{p_k} = x^k(p_k)$. As an unintended by-product of production, an externality is generated. We denote emission from sector k as e_k, and we assume the following functional relationship between x_k and e_k: $e_k=e^k(x_k)$, where $e_{p_k}>0$ and $e_{p_k p_k}\geq 0$. That is, the marginal effect of production on emission is non decreasing, e.g. because older and more polluting techniques are used when capacity use is high. Notice that since we model the externality as a by-product of production, the firms cannot substitute to a less polluting technology in response to environmental policy.

There are N identical consumers in the economy. They derive utility from consumption of the n+1 goods and disutility from the aggregate level of pollution, $E=\sum_{k=1}^{n} e_k$. Assume that utility is additively separable and quasi-linear[3]. We can then write the utility function for a representative consumer as follows:

$$U(\mathbf{c},E)=c_0+\sum_{k=1}^{n} u(c_k)-g(E) \qquad u'>0,\ u''<0,\ g'>0,\ g''\geq 0 \tag{1}$$

[3]This is, of course, a dubious assumption. As pointed out by Dixit, Grossman and Helpman (1996), it implies that utility is transferable, and that there is no limits to redistribution if the government has access to targeted lump sum taxation since the government has no inherited concern for the distribution of income.

We assume that utility from consumption is increasing in the quantity consumed, but at a decreasing rate, and that disutility of emission is increasing in the total level of emission at a non decreasing rate. From utility maximization subject to given income, I, domestic consumer prices, **q**, and taking emission as given, we derive the demand for the n non-numeraire goods as $d^k(q_k)$. The residual determines the demand for the numeraire good: $d^0(\boldsymbol{q}) = I - \sum_{k=1}^{n} d^k(q_k)$. We assume that $d^0(\mathbf{q})>0\ \forall q_k$ such that the wage rate is well defined. Consider now consumer h. She derives income from three sources. First, she supplies some labour, l_h, to the market. Secondly, she owns a share, $s_{k,h}$, of specific capital in sector k. To simplify, we assume that each individual owns claims to capital in at most one sector, i.e. for each h the share, $s_{k,h}$, is at most positive for one k and zero for all other k. One can think of capital as human capital, e.g. entrepreneurial skills, which is only usable in a particular sector. Thirdly, she gets a lump sum government transfer, r(**p**), financed by the environmental tax. Accordingly, we can write her indirect utility as

$$V^h(\boldsymbol{p},\boldsymbol{q},E) = l_h + \sum_{k=1}^{n} s_{k,h}\pi^k(p_k) + r(\boldsymbol{p}) + \sum_{k=1}^{n} u(d^k(q_k)) - \sum_{k=1}^{n} q_k d^k(q_k) - g(\sum_{k=1}^{n} e^k(x^k(p_k))),\ h = 1,....,N. \quad (2)$$

Aggregating over the N consumers leads to the following social welfare function:

$$W(\boldsymbol{p},\boldsymbol{q}) = l + \sum_{k=1}^{n} \pi^k(p_k) + Nr(\boldsymbol{p}) + N[\sum_{k=1}^{n} u(d^k(q_k)) - \sum_{k=1}^{n} q_k d^k(q_k)] - Ng(\sum_{k=1}^{n} e^k(x^k(p_k))) \quad \textbf{(3)}$$

The political process

The incumbent government has the authority to decide environmental policy. We will only consider price instruments, i.e. we do not allow for alternative instruments such as tradeable permits or quotas. Moreover, having specified emission as a by-product of production implies that a tax on emission, $e^k(x_k)$, and on production, $x_{k,}$ affect production decisions in the same way. To see this compare the profit maximization problem for, say, firm k under the two types of taxation. With a production tax, t_k^x, we have: $\max_{l_k} (p_k^* - t_k^x) f^k(l_k) - wl_k$. With an emission tax, t_k^E, we have: $\max_{l_k} p_k^* f^k(l_k) - wl_k - t_k^E e^k(f^k(l_k))$. Define $t_k^{x'}$ as the production taxed that corresponds to the emission tax t_k^E, i.e. $t_k^{x'} = t_k^E \frac{e_k}{x_k}$. That is, faced with an emission tax t_k^E the firm, being a price taker, acts as if it were solving the problem: $\max_{l_k} (p_k^* - t_k^{x'}) f^k(l_k) - wl_k$. Finally, if all consumers are identical except from their capital claims, proving that interfering with consumer prices is never optimal for the government is easy: A tax on consumption creates a deadweight loss without

generating any benefits, neither as more profits nor as reduced emission. Only if owners of capital in different sectors have different utility functions, there would be room for a consumption tax-cum-subsidy scheme in the political equilibrium [see Dixit (1995)]. Thus, here we can discard consumption taxes, and restrict the policy space to production taxes-cum-subsidies. We disregard **q** to simplify notation.

The net revenue from production taxes-cum-subsidies is then given as

$$Nr(\boldsymbol{p}) = \sum_{k=1}^{n} (p_k^* - p_k) x^k(p_k) \tag{4}$$

We assume that the government pursues its own goals. It cares both about political contributions and aggregate social welfare. The two motives are derived from outside the model. The former arises from the fact that contributions can be used to finance political campaigns or because they give the government more direct benefits as with bribes. With a democratic government that cares about reelection, social welfare matters as far as voters are more likely to reelect a government that, in the past, has provided high levels of general welfare. If the government is non-democratic, the motive may arise from fear of riots or coups. In sum, the objective function of the government is given as

$$G(\boldsymbol{p}) = \theta W(\boldsymbol{p}) + \sum_{j=1}^{m} C^j(\boldsymbol{p}) \tag{5}$$

where $C^j(.)$ is the contribution from lobby group j, m is the total number of lobbies and $\theta>0$ is the weight that the government puts on social welfare.

It is well known that the internal organization of lobbies is a complex matter [see Olson (1965)]. It is, for instance, obvious that the owners of the specific factor in any industry, k=1,..,n, have an incentive to organize a lobby group to protect industry profits against environmental taxes. However, since a reduction in taxation is like a public good, each specific factor owner prefers that the other factor owners in the industry take the necessary steps towards collective action. That is, free riding is a potential problem. We sidestep these problems and assume that various subgroups of the population manage to organize effective lobby groups. In section 4 to 7, we assume that in a subset, L, of the n industries, the capital owners form an efficient lobby group. The $m \leq n$ lobbies make a political contribution that is contingent on the environmental

policy chosen by the government. That is, each lobby offers the government a menu of contributions given by the function $C^j(\mathbf{p})$. The remaining n-m industries do not organize, and since individual agents are too small to communicate their political demands efficiently, there will be no political contributions from these industries. Lobby group j chooses its contribution function to maximize the welfare of its members. If there are N_j members of lobby group j, we can derive the gross welfare function for the lobby from equation (2):

$$W^j(\mathbf{p}) = l_j + \pi^j(p_j) + s_j N r(\mathbf{p}) + s_j N[\sum_{k=1}^{n} u(d^k(q_k)) - \sum_{k=1}^{n} q_k d^k(q_k)] - s_j N g(\sum_{k=1}^{n} e^k(x^k(p_k))), \qquad \textbf{(6)}$$

where s_j is the share of the total population organized in lobby group j (N_j/N). The objective functions of the lobby groups show that each lobby has multiple goals. That is, each lobby cares about industry profit, environmental damage to the membership and transfers from the government. Each lobby faces a trade off between protecting profits and protecting the environment. That is, a lobby would like a low tax or, even better, a subsidy to protect profits in its own industry, but, from an environmental point of view, it would rather have high taxes in all industries to take care of the externality. In section 8, we consider the case of functionally specialized lobby groups in which the internalization solely arises from competition between ideologically motivated groups. To be specific, we assume that a subset of the n industries organizes a producer lobby that only cares about industry profits, and that a subset of the citizens, the environmentalists, organizes an environmentalist lobby that only cares about the environment.

3. The Pigouvian Equilibrium

In this section, we will take a Pigouvian approach and assume that the government is benevolent in the sense that it cares only about aggregate social welfare and is not at all responsive to pressure from organized lobby groups. So, the government chooses environmental policy to maximize (3). It can levy a specific tax on production in each sector. The tax-cum-subsidy is by definition $t_k = p^*_k - p_k$. Since world prices are exogenously given, we can without loss of generality talk about **p** as if it were the policy vector itself. Accordingly, we formulate the policy problem in terms of **p** rather than in terms of **t**. The first order conditions for an interior maximum are

$$\frac{\partial W}{\partial p_k} = (p_k^* - p_k) x_{p_k}^k(p_k) - N[g_E e_{x_k}^k x_{p_k}^k(p_k)] = 0 \qquad \textbf{(7)}$$

Notice the trade off involved in maximizing social welfare. A production tax increases the domestic producer price and creates a deadweight loss due to the deviation from the world market price. On the other hand, a tax helps to internalize the externality. The second order condition is satisfied if $x_{p_k p_k} \geq 0$. Rewriting (7), we get an implicit formula for the environmental tax:

$$(p_k^* - p_k) = t_k^p = N g_E e_{x_k}^k > 0, \quad k = 1,..,n. \qquad \textbf{(8)}$$

That is, the Pareto Optimal policy scheme is to tax production in each industry according to the social marginal damage that production causes the society. In our case firms reduce emission via a reduction in domestic production. Since demand is unchanged (with quasi linear preferences there is no income effect on consumption of the n non-numeraire goods) more goods are imported from abroad. This generates presumably more emission abroad, but since any emission generated in production abroad does not harm domestic consumers, the domestic government does not consider this.

4. Environmental Policy in a Political Equilibrium

At the political equilibrium, environmental policymaking involves a mixture of Coasian and Pigouvian elements. The government cares about social welfare, but also about campaign contributions. The producers in some industries organize lobby groups to protect their interests and lobby the government for a favourable environmental policy. Formally, the relationship between the lobbies and the government takes the form of a common agency. The lobby groups are the principals and the government is the agent.

In the political equilibrium, environmental policy and campaign contributions from the m lobby groups are determined as a subgame perfect Nash Equilibrium. In particular, an equilibrium consists of a collection of contribution schedules $\{C^j(p_j)\}$ and a policy vector $\mathbf{p}$. We solve the game in two stages. In stage one, each lobby group determines an optimal political contribution as a function of environmental policy, taking the contribution schedules of the other lobbies and

the anticipated political optimization by the government in stage two as given. The result is a menu of optimal political contributions that are contingent on **p**: $C^j(\mathbf{p})$. In the second stage the government, taking the contribution schedules as given, determines the optimal environmental policy, i.e. **p**, and collects the political contributions from the lobbies[4].

To characterize the structure of environmental policy, we assume that the contribution schedules are locally differentiable. First, consider stage two. The government chooses, **p**, to maximize its own welfare given in (5) taking the schedules, $C^j(p)$, as given. The first order condition is

$$\nabla G(\boldsymbol{p}) = \theta \nabla W(\boldsymbol{p}) + \sum_{j=1}^{m} \nabla C^j(\boldsymbol{p}) = 0 \qquad \textbf{(9)}$$

Secondly, consider stage one. Each lobby takes the contribution schedules of the other lobbies as given. Consider lobby group j. Since it takes the contribution schedules of the other lobbies as given, it faces a bilateral bargaining situation with the government. The government's outside option is to choose the best policy action in response to the contribution schedules offered by the other lobbies. Therefore, lobby group j must give the government at least this level of utility, and subject to this constraint the group chooses its contribution schedule to maximize its welfare. This implies that the lobby group picks a schedule that maximizes the surplus that arises from the bilateral relationship between itself and the government. To see why this must be the case, suppose that a lobby group did not choose its contribution schedule according to this rule. Then, the group could change its contribution schedule to induce the government to choose the policy that maximizes the surplus of the bilateral relationship. That would generate more surplus, and the lobby could secure at least some of this surplus[5]. Define $\mathbf{p}_{-j}$ as the producer prices that would arise from the political optimization if lobby j did not contribute to politics. Then, the government's bilateral surplus in the relationship with lobby group j is

$$\theta W(\boldsymbol{p}) + \sum_{l=1}^{m} C^l(\boldsymbol{p}) - \theta W(\boldsymbol{p}_{-j}) - \sum_{l=1,\ l\neq j}^{m} C^l(\boldsymbol{p}_{-j}) \qquad \textbf{(10)}$$

The bilateral surplus of lobby group j is given as

[4]Here, it is implicitly assumed that the lobbies´ offers are binding.

[5] In fact, Grossman and Helpman (1994) show in footnote 6 that the lobby can secure most of the surplus.

$$W^j(\boldsymbol{p}) - C^j(\boldsymbol{p}) - W^j(\boldsymbol{p}_{-j}) \qquad \textbf{(11)}$$

Hence, total surplus is

$$B_j = \theta[W(\boldsymbol{p}) - W(\boldsymbol{p}_{-j})] + \sum_{l=1,\ l\neq j}^{m} [C^l(\boldsymbol{p}) - C^l(\boldsymbol{p}_{-j})] + [W^j(\boldsymbol{p}) - W^j(\boldsymbol{p}_{-j})] \qquad \textbf{(12)}$$

We now use the property of local controllability [see Dixit (1995)], i.e. the property that the lobby group, by changing its contribution schedule, can vary **p** in any direction near the equilibrium. So, we let the lobby maximize (12) as if it were controlling **p**, directly. The first order condition is

$$\theta \nabla W(\boldsymbol{p}) + \sum_{l=1,\ l\neq j}^{m} \nabla C^l(\boldsymbol{p}) + \nabla W^j(\boldsymbol{p}) = 0 \qquad \textbf{(13)}$$

In any Nash equilibrium of the game, (9) and (13) must be satisfied simultaneously. Thus, substitute (9) into (13) to get

$$\nabla W^j(\boldsymbol{p}) = C^j(\boldsymbol{p}) \qquad \textbf{(14)}$$

Equation (14) is the condition of local truthfulness. The contribution schedule is truthful in the sense that at the equilibrium it reveals the true marginal properties of the lobby group's gross welfare function. Now, sum (14) over the m lobbies and use the government's first order condition to get

$$\theta \nabla W(\boldsymbol{p}) + \sum_{j=1}^{m} \nabla W^j(\boldsymbol{p}) = 0 \qquad \textbf{(15)}$$

Equation (15) can be used to characterize equilibrium environmental policy[6]. However, to characterize the contribution schedules fully, the condition of local truthfulness is not sufficient. In fact, although the condition is necessary for an interior equilibrium in differentiable strategies, the contribution schedules can, in principle, take many different forms, and the game can have infinitely many Nash equilibria. By focussing on truthful strategies, we can select among the many

[6]Assuming that the second order conditions corresponding to (10) and (14) are satisfied.

Nash equilibria. We postpone the discussion of this to section 7. Here, we concentrate on the characterization of the equilibrium structure of environmental policy.

Substitute the government budget from (4) into welfare function of lobby group j, (6), and take the partial derivative with respect to the k'th price. Define $\delta_{kj}=1$ if k=j and $k\in L$ and zero otherwise. Then we have

$$\frac{\partial W^j(\boldsymbol{p})}{\partial p_k}=(\delta_{kj}-s_j)x^k(p_k)+s_j(p_k^*-p_k)x_{p_k}^k(p_k)-s_jNg_Ee_{x_k}^kx_{p_k}^k(p_k) \qquad \textbf{(16)}$$

When lobby group j considers contributing to politics to change the k'th price slightly from the world market level, different incentives are involved. If k=j, the first term calls for a subsidy, while the last term calls for a tax. That is, a subsidy is called for to increase profits and factor income of members, whereas a tax is called for to take care of the adverse effects of emission incurred by the lobby's members. If $k\neq j$, the two terms agree: A tax on output in other industries is desirable, both because it generates government revenue and because it helps reduce emission.

Now, sum the expression in (16) over all $j\in L$ to get the "total" marginal impact of price changes on the welfare of the group of organized industries

$$\sum_{j\in L}\frac{\partial W^j(\boldsymbol{p})}{\partial p_k}=(I_k-s_L)x^k(p_k)+s_L(p_k^*-p_k)x_{p_k}^k(p_k)-s_LNg_Ee_{x_k}^kx_{p_k}^k(p_k) \qquad \textbf{(17)}$$

where $I_k=\sum_{j\in L}\delta_{jk}$ and $s_L=\sum_{j\in L}s_j$. That is, $I_k = 1$ if industry k is organized and zero otherwise, and s_L denotes the proportion of total population that owns capital in organized sectors.

Substitute (17), along with the expression for the change in social welfare given in (7), into (15):

$$(I_k-s_L)x^k(p_k)+s_L(p_k^*-p_k)x_{p_k}^k(p_k)-s_LNg_Ee_{x_k}^kx_{p_k}^k(p_k)+\theta[(p_k^*-p_k)x_{p_k}^k(p_k)-Ng_Ee_{x_k}^kx_{p_k}^k(p_k)]=0 \qquad \textbf{(18)}$$

Rewrite equation (18) to get an implicit solution for the optimal structure of the environmental tax-cum-subsidy

$$p_k^*-p_k=-\frac{I_kx^k(p_k)}{(s_L+\theta)x_{p_k}^k(p_k)}+\frac{s_Lx^k(p_k)}{(s_L+\theta)x_{p_k}^k(p_k)}+g_ENe_{x_k}^k(p_k) \;=\; -\frac{(I_k-s_L)x^k(p_k)}{(s_L+\theta)x_{p_k}^k(p_k)}+t_k^p(p_k) \qquad \textbf{(19)}$$

In line with the three (partly) conflicting goals of the lobbies, the price structure reflects three concerns. The first term is organized industries' concern with profits. The second term is the concern about transfers from the government. The third term captures environmental concerns. While the two first terms are associated with income distributional motives of the lobby groups and correspond closely to the results of Grossman and Helpman (1994) and Dixit (1995), the third term captures the fact that competition between lobby groups with multiple goals internalizes the externality. Evaluated at the appropriate price vector, the third term is nothing but the Pigouvian tax. Hence, we have

Proposition 1.

Independent of θ, the price structure in the political equilibrium reflects the full Pigouvian adjustment.

That is, although each lobby only cares about the environmental damage to its own membership and not all citizens are organized, competition between lobby groups internalizes the externality to the extent of the full Pigouvian adjustment. Moreover, we notice that the internalization (but not the income distributional terms) is independent of whether or not the government cares about social welfare, i.e. the political internalization takes place even if $\theta=0$, and, accordingly, solely arises from the Coasian element of mobilization of the effected parties. The reason the full Pigouvian adjustment is reflected in the price structure is that the both the distortion cost, $(p_k^* - p_k)x_{p_k}^k$, and the environmental damage term, g(E), are proportional to the organized groups' population share, and, so, the two concerns have equal weight in the balancing considerations of the society.[7]

The income distributional motives of the lobby groups imply that the tax structure in the political equilibrium does not replicate the social optimum. It is of interest to consider in more detail how the political optimal tax structure deviates from the Pigouvian rule. Equation (19) only gives an implicit solution. However, if $t_k^p(p_k)$ does not increase too fast in p_k and the supply function is "well behaved," then we can conclude that the equilibrium tax in organized sectors,

[7]Notice that the lobby groups' concern about the distortion cost is related to their concern about government transfers. Hence, if the government gave organized citizens less (more) of government revenue than their population share, then they would care less (more) about the distortion cost, and, accordingly, the environmental adjustment would be greater (smaller) than the Pigouvian adjustment.

t_k^o, is lower than the Pigouvian tax, t_k^p, whereas in unorganized sectors it is bigger, i.e. $t_k^u > t_k^p$. This follows from the fact that the sum of the two income distributional terms is negative in organized sectors and positive in unorganized sectors. We summarize the result in the next proposition.

Proposition 2.

Suppose $g_{E,E} = e^k_{x_k,x_k} = 0$. Then $t_k^u > t_k^p > t_k^o$.

Proof. The assumption that $g_{E,E} = e^k_{x_k,x_k} = 0$ implies that $t_k^p(p_k)$ is independent of p_k. Hence, the result follows from inspection of (19)□

Consider an organized industry (I_k=1). In these industries the inherent demand for an environmental tax according to social marginal damage is insufficient to implement the Pigouvian tax. Organized industries get a tax discount under fairly general conditions. If the profit motive is sufficiently strong compared with environmental concerns, some industries may even get a *subsidy* from the government. We will return to the issue in the next section. Next, consider an unorganized industry (I_k=0). These industries pay more than the Pigouvian tax in equilibrium. That is, organized industries, not only lobby to get a tax discount for themselves, they also lobby for taxes in unorganized industries to reduce emission and to generate more government revenue, part of which the government transfers to organized citizens.

So, the political internalization of the negative production externality takes place through two channels. First, organized industries accept higher taxes than they would have done based on their distributive objectives alone. Secondly, organized industries lobby for environmental taxes in unorganized industries. Since these are not represented directly in the political process, organized industries can transfer a disproportionate share of the abatement cost to these sectors.

In plain words, each lobby tells a tale of the following type to the government: “Look, our industry is very special. We know that we also pollute and we are willing to accept a minor environmental tax, but you must understand that we cannot undertake major environmental adjustments without loss of employment. Yes, we may even have to move production abroad. On the other hand, look at all those other industries. They really pollute a lot and are in a much better position to adjust than we are. What about taxing them instead?”

5. Emission in the Political Equilibrium

It is often argued by environmentalists that whenever industry lobby groups get a say in environmental policy, firms emit too much pollution. Is this kind of reasoning in line with the principle of political internalization of externalities? Regarding emission from each sector, the following result follows immediately from proposition 1

Corollary

Let e_k^o and e_k^u be emission in organized and unorganized sectors, respectively. Then,

$$e_k^o \geq e_k^p \geq e_k^u \qquad \textbf{(20)}$$

If either all or non of the industries are organized, then emission from all (either organized or unorganized) industries are efficient, i.e. $e_k = e_k^p$ for all k.

Proof. The first part follows from the fact $e^k(x^k(p_k))$ with $e_{x_k} > 0$ and $x_{p_k} > 0$. The second part can be verified by substituting ($s_L=1$ and $I_k=1, \forall$ k) and ($s_L=0$ and $I_k=0, \forall$ k) into (19), respectively□

That is, more emission than what is socially desirable is emitted from organized sectors, while firms in unorganized sectors emit less. This reflects the fact that organized sectors manage to shift part of the tax burden to unorganized sectors. It follows that the overall level of pollution in the political equilibrium is generally inefficient depending on the values of various parameters. Hence, the principle of political internalization is not sufficient to insure a social optimum, but, on the other hand, it does not necessarily lead to excessive emission either[8].

However, if we compare the political equilibrium with a Laissez-faire equilibrium with no policy interventions at all, things look quite different. Here, political internalization of the production externality will almost surely decrease overall emission. A necessary condition for emission to increase compared with the Laissez-faire equilibrium is that some organized sectors get so large

[8]Notice, however, that environmentalists are right about the level of emission in the (very) special case in which all sectors have the same quadratic profits functions and linear emission functions. In that case, total emission is (weakly) higher than the Pigouvian level for all values of m.

subsidies that overall emission increases. A most unlikely scenario[9]. Furthermore, in a Laissez-faire equilibrium production is far too high and a move in the direction of lower production and emission is beneficial if profit is not depressed too much by the move.

Notice, that in at least two cases, the optimal level of emission is realized in the political equilibrium. It is obviously the case if no industries are organized, since then no contributions are made and the government is simply maximizing social welfare. However, it is also the case if all industries are organized *and* all voters own capital. Under these conditions, the rivalry between lobbies is so large that no one manages to transfer income from any of the others. Their lobbying efforts simply cancel and the government imposes a Pigouvian tax in each sector[10].

6. Quadratic Profit Functions and a Linear Emission Function

To gain more insight into the nature of the political equilibrium, we introduce specific functional forms. In this section, we derive a closed form solution and comparative statics. In section 7, we derive the nature of the contribution schedules under the assumption of global truthfulness.

We assume that profit functions are quadratic[11], i.e.

$$\pi^k(p_k) = \tfrac{1}{2}\alpha_k p_k^2 \qquad \textbf{(21)}$$

Accordingly, supply is linear

$$\pi^k_{p_k}(p_k) = x^k(p_k) = \alpha_k p_k \qquad \textbf{(22)}$$

Moreover, we assume that g(E)=E, and that emission from industry k is given as a linear function of the output

[9] It is straight forward to prove this assessment under the assumptions of the previous footnote. However, with strong asymmetries in technology or marginal emission coefficients the assessment may not be true.

[10] The assumption that each agent owns capital in only one sector, if in any, is important. Suppose we introduce a competitive stock market that allows ownership claims to be traded. Then surely they would be held more widespread. A fact that would reduce the beggar-thy-neighbour element of the lobbying game. In fact, we believe that, if everybody holds a proportional share of capital in every sector, the political equilibrium would be efficient.

[11] This profit function can be derived from a Cobb-Douglas technology with a capital share in all sectors of ½.

$$e^{k}(x^{k}(p_k)) = c_k \alpha_k p_k \qquad \textbf{(23)}$$

To make the analysis meaningful, we assume that production in all sectors is weakly positive in the Pigouvian equilibrium. That is,

$$p_k^* \geq N c_k = t_k^p \quad \forall\ k \qquad \textbf{(24)}$$

The assumption states that if good k is produced domestically, then it must be the case that the value of the good at the world market is greater than the social marginal damage involved in producing it.

Recall that we only got an implicit expression for the equilibrium tax structure in (19) since p_k appears at the right-hand side via the supply function. However, using the functional forms, we derive the reduced form tax equation:

$$\begin{aligned} t_k^o &= \frac{-(1-s_L)(p_k^* - t_k^p)}{(2s_L + \theta - 1)} + t_k^p \leq t_k^p \quad for \quad k \in L \\ t_k^u &= \frac{s_L(p_k^* - t_k^p)}{(2s_L + \theta)} + t_k^p \geq t_k^p \quad for \quad k \notin L \end{aligned} \qquad \textbf{(25)}$$

It follows from the second order condition for a maximum that $2s_L+\theta-1>0$. Proposition 1 is immediately confirmed from equation (25). Moreover, we see that organized sectors get a subsidy if

$$p_k^* > \frac{s_L + \theta}{1 - s_L} t_k^p = A t_k^p \qquad \textbf{(26)}$$

where A>1 by the second order condition. We notice that an organized industry is more likely to get a subsidy if 1) the margin between the world market price and the Pigouvian tax is large in that particular industry, 2) the government cares only little about social welfare ($\theta \rightarrow 0$) and 3) only an infinitesimal fraction of the population owns capital in organized sectors ($s_L \rightarrow 0$).

Consider some comparative static results. First, let the government's weight on social welfare, θ, increase. Then, the equilibrium tax increases in organized sectors and decreases in unorganized sectors. This is quite intuitive. Since the government becomes more concerned about social welfare, it is less responsive to contributions from the lobby groups. Equilibrium policy therefore converges towards the Pigouvian tax rates. In turn, this implies a reduction of the tax rebate in organized sectors and a tax relief in unorganized sectors. Secondly, let the proportion of factor owners in organized sectors, s_L, increase. Then, the equilibrium tax rate in *all* industries increases. In organized industries taxes increase because lobby groups can exploit a smaller unorganized proportion of the population and because the organized industries overall are more concerned about the environmental impact of production. In unorganized sectors, taxes increase partly because of increased environmental awareness of the lobbies and partly because the organized lobbies intensify their bidding on taxes in these industries to get more funds transferred from the government budget. Thirdly, the tax rate in a given industry is increasing in the marginal impact of emission, c_k, from that sector. Finally, taxation in all industries is increasing in the size of the population, N. This is, of course, because the negative welfare consequence of production being felt by more people.

Let e_k^p be emission in the Pigouvian equilibrium. By means of (22), (23) and (25), we derive the equilibrium level of emission from each sector and notice that the corollary is confirmed

$$\begin{aligned} e_k^o &= c_k\alpha_k\left[\frac{(p_k^* - t_k^p)(s_L+\theta)}{\theta+2s_L-1}\right] = \frac{(s_L+\theta)}{\theta+2s_L-1}e_k^p \quad for \quad k\in L \\ e_k^u &= c_k\alpha_k\left[\frac{(p_k^* - t_k^p)(s_L+\theta)}{\theta+2s_L}\right] = \frac{(s_L+\theta)}{\theta+2s_L}e_k^p \quad for \quad k\notin L \end{aligned} \tag{27}$$

To see how the total level of emission depends on the degree of organization with only a subset of industries organized, we label the industries such that all industries with index $k\leq m$ are organized while those with index $k>m$ are not. Furthermore, assume that we normalize the number of factor owners in the n sectors such that we can write the proportion of factor owners in organized sectors as $s_L=m/n$. Then, the change in total emission when the number of organized industries increases from m to m+1 is given as

$$\Delta E_m = e^p_{m+1}\left[\frac{\theta\left(1-\frac{1}{n}\right)+\frac{(m)}{n}}{\left(\frac{2(m+1)}{n}+\theta-1\right)\left(\frac{2m}{n}+\theta\right)}\right]+\sum_{k=1}^{m} e^p_k\left[\frac{\frac{-(1+\theta)}{n}}{\left(\frac{2(m+1)}{n}+\theta-1\right)\left(\frac{2m}{n}+\theta-1\right)}\right] + \sum_{k=m+2}^{n} e^p_k\left[\frac{\frac{-\theta}{n}}{\left(\frac{2m}{n}+\theta\right)\left(\frac{2(m+1)}{n}+\theta\right)}\right] \quad \textbf{(28)}$$

We see that an increase in the number of organized industries has two effects on the total level of emission. First, total emission from the newly organized industry increases (the first term). Secondly, the proportion of organized factor owners increase. This decreases emission from all sectors, because the equilibrium tax is higher in each sector. This is reflected by the last two terms.

7. Contribution Schedules With Truthful Strategies

As argued in section 4, the assumption of differentiable strategies is not sufficient to pin down the shape of the contribution schedules. To this end, we use the assumption of (global) truthfulness. A truthful strategy is one in which the political contribution schedule of a lobby group everywhere reflects the true preference of the lobby, i.e. $C^j(\mathbf{p})$ is equal to the lobby's gross welfare function W^j minus a constant. As pointed out by Bernheim and Winston (1986), an equilibrium in truthful strategies has desirable properties. First, the equilibrium is coalition proof. Secondly, a truthful strategy is efficient in the sense that it maximizes the bilateral surplus between each lobby and the government, i.e. the optimal price vector satisfies $\mathbf{p^o}=\text{argmax}_{\mathbf{p}\in P}\,[\sum_{j\in L} W_j(\mathbf{p}) + \theta W(\mathbf{p})]$, and, so, necessarily equation (15). Holding on to the functional forms introduced in section 6, a truthful equilibrium can be carried out in linear strategies of the type [see Dixit 1995]

$$C^j(\boldsymbol{p}) = \sum_{k=1}^{n} \gamma_{k,j} p_k + z_j \quad \textbf{(29)}$$

where $\gamma_{k,j}$ is the marginal contribution from lobby group j to the government in response to a change in the producer price in industry k, and z_j is a constant that shifts surplus from the lobby to the government. That is, with the given assumptions, we can calculate the coefficients in the incentive schemes offered by the principals to the agent.

Again we solve the game in two steps. At stage 2 of the game the government maximizes its own welfare. At stage 1 each lobby chooses a contribution schedule that maximizes the surplus arising from the bilateral relationship between itself and the government. The coefficients of the contribution schedule, of course, reflect the marginal effect of price changes on a lobby group's welfare

$$\frac{\partial W^l}{\partial p_k} = \gamma_{k,j} = \alpha_k(s_l(p_k^* - p_k) + (\delta_{l,k} - s_l)p_k - s_l Nc_k) \qquad \textbf{(30)}$$

Now, substitute (19) into this equation and make use of the functional forms to get the reduced form for the contribution schedule

$$\gamma_{k,l} = \frac{\alpha_k(p_k^* - t_k^p)}{\theta + 2s_L - I_K}[\delta_{l,k}(\theta + s_L) - s_l(I_k + \theta)] \qquad \textbf{(31)}$$

The sign of the last bracket determines the sign of $\gamma_{k,l}$. There are three cases to consider. First, let l=k, then the last bracket reads $[\theta(1-s_L)+(s_L-s_l)]$ which is clearly positive. That is, lobby group l rewards the government for higher prices or lower taxes in its own sector. Second, if $l \neq k$, but $k \in L$, then the last bracket reads $[-s_l(1+\theta)]$ which is negative. In other words, lobby group l contributes less if the government reduces the tax in other organized sectors. Finally, let $l \neq k$, but $k \notin L$, then the bracket is reduced to $[-s_l\theta]$. That is, lobby l rewards the government for taxing production in unorganized sectors at a high rate. Verifying that lobby group l, at the marginal, rewards tax increases in unorganized sectors more than it does in other organized sectors is easy.

8. Functionally Specialized Lobby Groups

The driving force behind the political internalization analysed in the previous sections is competition between lobby groups with *multiple goals*. As discussed in the introduction, political

internalization can also arise from competition between *functionally specialized* lobby groups. In this section, we consider how specialization affects the political equilibrium of the basic model. That is, we analyse the case in which some profit-minded industry lobbies compete against an environmentalist lobby.

Assume that a fraction, s_E, of the population, the environmentalists, organize in a grand lobby[12]. The only concern of the lobby group is to protect the environment, and, hence, to lobby the government for environmental protection in the n productive sectors. The members, of course, derive utility from consumption and income from their labour supply and possibly also from ownership claims to capital, but they do not care about profits or the distribution of tax revenue. The gross welfare function of the lobby is $W_E = A - s_E N g(\sum_{k=1}^{n} e_k(x_k(p_k)))$. A is a constant. Morever, in some industries capital owner form lobbies with objectives $W_j=\pi_j(p_j)$, i.e. they only care about industry profit. Using the same methodology as in section 4, we derive the tax structure in the political equilibrium as

$$(p_k^* - p_k) = \frac{(\theta + s_E)}{\theta} t_k^p(p_k) - \frac{I_k x^k(p_k)}{\theta x_{p_k}^k} \qquad \textbf{(32)}$$

The price structure reflects the balancing of the capitalist lobbies' concern for profit, the environmentalists' concern for pollution and the government's concern for social welfare. We notice that the environmental adjustment is greater than the Pigouvian adjustment. This is because both the government and the environmentalists care about environmental damage, while only the government, via its concern about social welfare, cares about the distortionary cost of taxation. Hence, environmental damage is given more weight, $(\theta + s_E)$, than the distortionary cost of taxation, (θ), in the political trade off. Moreover, we see that capitalist lobby groups get a discount to their industries that can be weighted against the environmental tax arising from the fact that also the environmentalists offer campaign contributions. Finally, since non of the lobby groups are concerned with transfers from the government budget, the beggar-thy-neighbour element of environmental lobbying is substantially reduced.

[12]Though the environmentalists only represent a fraction, s_L, of the population, they may for ideological reasons care about the total effect of emission. That is, they may act as if $s_E=1$.

9. Concluding Remarks

This paper points out that competition between lobby groups is an important source of internalization of economic externalities. Both the competitive political process in which the groups participate and the multiplicity of goals within a given group, who adjusts its economic objectives to reflect environmental concerns, contribute to the internalization. We show, in common agency model of politics, that the Pigouvian adjustment is fully reflected in the price structure of the political equilibrium. However, due to the lobbies' income distributional concerns, the politically optimal environmental policies are different from the set of Pigouvian taxes needed to achieve the social optimum. That is, organized sectors get a tax discount (sometimes) at the expense of the unorganized sectors. Hence, at the political equilibrium, emission is not efficient, and the direction of the inefficiency cannot, in general, be determined.

We make some simplifying assumptions in our analysis. The main simplifying assumption concerns the specification of technology and the choice of policy space. Recall that we model the externality as a by-product of output. Thereby, we exclude the possibility that a firm, in response to environmental policy, can substitute to a less pollution-intensive technology. Moreover, production and emission taxes-cum-subsidies are equivalent, and, so, the choice between a pollution tax and a production tax cannot be considered. In Aidt (1997), we extend the model to include a more flexible specification of the externality that allows firms to substitute to cleaner production technics in response to environmental policy. We assume that firms demand an input, raw materials, the use of which pollutes. The main additional insight from the paper is that the Bhagwati's principle of targeting [see Bhagwati (1971)] generalizes to distorted political markets. That is, the competitive political process internalizes the externality by means of the most efficient instrument, i.e. the one that aims directly at the source[13]. Moreover, the spillover between production and raw material taxes dampens the distributionally motivated distortion of the domestic price structure.

In the various versions of the model, we only consider price instruments. However, one puzzle in environmental economics is why price instruments are so rarely used in real life. The most

[13]The generalization of the principle of targeting is in line with Dixit, Grossman and Helpman (1996) and Becker (1983, 1985). Becker argues that more efficient methods of taxation are unanimously preferred by everybody because of a lower dead weight loss. In the common agency model of Dixit, Grossman and Helpman (1996), more efficient instruments are chosen, because the government cares (partly) about social welfare. The lobbies prefers redistribution by means of inefficient instruments.

frequently used environmental regulation instrument is after all direct controls. Buchanan and Tullock (1975) explain why direct controls may be preferred to taxes. The basic idea is that, whereas short-run losses are necessary injured under a tax scheme, direct control may produce over normal profits. Therefore, firms and employees will oppose the tax and favour direct controls. It is left to future research to see if the competitive political process captured by the common agency model of politics would also favour direct controls over taxes.

The final simplifying assumption of the common agency model is that the set of organized industries is exogenously fixed. However, capital owners in each industry trade off the cost of organization with the benefit of affecting environmental policy when they decide whether to form a lobby or not. In some industries with only a few big firms, the cost of organization is likely to be relatively small, while, if industry output is also high, the gains from organization are large. Accordingly, we expect that industries in which a few big firms produce a high level of output are more likely to organize than those with the opposite characteristics. In any case, it would be of interest to endogenize the set of organized industries.

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