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Political internalization of economic externalities and environmental policy

Toke S. Aidt*

University of Aarhus, Department of Economics, Building 350, Dk-8000 Aarhus C, Denmark

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Abstract

This paper derives the characteristics of endogenous environmental policy in a common agency model of politics, and proceeds to show that competition between lobby groups is an important source of internalization of economic externalities. Our analysis generalizes Bhagwati's principle of targeting to the case of distorted political markets. Moreover, we show that the politically optimal structure of environmental taxes incorporates a 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 Pigouvian rule. © 1998 Elsevier Science S.A.

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1. Introduction

As stressed by the traditional public-choice approach to economics, economic policy, including environmental policy, is determined by political and economic self-interest. In a pioneering paper, Buchanan and Tullock (1975) point out that economic agents (e.g. firms) are motivated to influence environmental policy because the choice of instrument has income distributional consequences. Another

*Corresponding author. Tel.: +45 8942 1496; fax: +45 8613 6334; e-mail: taidt@eco.aau.dk

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reason why lobby groups seek influence on environmental policy is that pollution reduces welfare directly.

This paper is based on the notion that environmental policy is a product of political self-interest, and proceeds to show that political competition is an important source of internalization of economic externalities. The underlying idea is simple: lobby groups give voice to different aspects of environmental policy making sure 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 lobby groups that have multiple goals. A functionally specialized lobby group acts as an advocate for only one aspect of environmental policy. Accordingly, 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 discussed in many European countries and implemented in some. Here, environmentalists seek a high common duty on CO_2 emission, whereas producer interests seek as low a duty as possible. Some lobby groups, like trade unions and employers' associations, advocate multiple goals reflecting the variety of interests that their membership has. Environmental concerns, accordingly, enter the agenda to the extent that environmental protection is 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 blueprint 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 provide evidence of multiple goals. That is, besides wanting to reduce their share of the total cost of reduction (the beggar-thy-neighbour element of lobbying), these lobby groups voluntarily accepted to reduce emission.

The idea of political internalization of externalities brings together elements of the Coasian (see Coase, 1960) and Pigouvian (see, e.g. Baumol and Oates, 1989) 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 minimizes 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 interest of the voters. In a sense, we may say that the public-choice axiom of political self-interest bridges the Coasian and Pigouvian approach to environmental policy.

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 Grossman and

Helpman (1994).[1] 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 arises because of a production externality. We assume that firms in each industry use an input (raw materials, clean water etc.) that has an external effect on the well-being of consumers (smoke, toxic waste water etc.). Furthermore, we assume that the government has access to two environmental policy instruments. Production taxes-cum-subsidies can be used to affect activity in the various sectors, and, by that, presumably the use of the externality generating input. Input taxes-cum-subsidies, which in our specification are equivalent to pollution taxes-cum-subsidies, can be aimed directly at the source of the externality, and by that presumably give firms an incentive to use a cleaner production technology.

Independently of whether lobby groups have multiple goals or are functionally specialized, only the tax-cum-subsidy on the externality generating activity (called raw materials) includes an environmental adjustment. Accordingly, we have a political economy version of Bhagwati's principle of targeting: the competitive political process internalizes the externality by means of the most efficient instrument, i.e., the one that aims directly at the source. Moreover, the environmental adjustment of the raw material tax reproduces the Pigouvian adjustment. In particular, if environmental damage and the distortionary cost of raw material taxation receive equal weight in the political trade off, then the price structure reflects the full Pigouvian adjustment. Due to the various income distributional considerations that enter the political trade off, the political equilibrium does, of course, not replicate the social optimum. In particular, under plausible conditions, sectors that have a lobby group to further their profit interests get a production subsidy and pay a reduced raw material tax (compared to the Pigouvian level). Moreover, if lobby groups have multiple goals, including a desire for monetary transfers from the government, then the government taxes unorganized sectors at an inefficiently high rate to produce extra tax revenue, part of which the government distributes among organized citizens.

Our analysis is part of a growing literature on positive environmental economics. In one branch of this literature, the interaction between trade and environmental policy is brought into focus. Bommer (1996); Bommer and Schulze (1997) consider the effect of trade liberalization on endogenous environmental policy, while Hillman and Ursprung (1992, 1994) introduce environmental lobby groups in a model of endogenous trade policy. While not at the forefront of the analysis, these papers, implicitly, rely on a notion of political internalization of externalities. In another, more recent branch of the literature, which has developed independently of our paper, Schleich (1997) and Fredriksson (1997) consider

[1]The basic common agency model is due to Bernheim and Whinston (1986). It has previously been applied to trade policy (see Grossman and Helpman, 1994, 1995a,b) and commodity taxation (see Dixit, 1996; Dixit et al., 1997).

environmental policy within the framework of a common agency model of politics similar to ours. Both papers consider externalities related directly to output or to consumption, and, so, the structure of their political equilibrium differs considerably from ours. In particular, the generalization of the principle of targeting is a specific feature of our model. Likewise, neither of the papers focuses on the issue of political internalization. Schleich (1997) analyses the choice between domestic price instruments and trade policy in the presence of a consumption and production externality. Two interesting results emerge. First, if the externality is related to consumption, then the political equilibrium fully internalizes the externality by means of a consumption tax. Second, if the externality is related to output, then it is uncertain in terms of the effect on environmental quality whether a production tax-cum-subsidy or trade intervention is the most effective. Fredriksson (1997) considers a pollution tax in a model with functionally specialized lobby groups. A special feature of his model is that firms can, at a cost, invest in pollution control that reduces emission per unit of output. It is shown that a subsidy to pollution control may, due to the endogenous response of lobby groups, lead to an increase in total pollution.

The common agency model of politics, as developed by Grossman and Helpman (1994), is a promising workhorse model of special-interest group politics. It is well-suited to analyse the structure of economic policy across a set of industries and to analyse the choice between various policy instruments.[2] However, applying this model is not without problems. First, at the heart of a common agency model with perfect information is a coordination problem among the principals. Bernheim and Whinston (1986) show existence of an efficient equilibrium, i.e., an equilibrium that is efficient for the group of active players (here, the lobby groups and the government). It is this equilibrium, we, as do Grossman and Helpman (1994) and others, focus on. This has an important implication. If all agents have their interests represented by a lobby group, then the political equilibrium is socially efficient, leading to a complete political internalization of the externality. Accordingly, the internalization is incomplete because some citizens do not organize lobby groups. Unfortunately, it is hard, within the model, to justify why some people can overcome the free rider problem of collective action and coordinate perfectly, while others cannot. Accordingly, we must resort to an implicit assumption that some groups face much lower organizational cost or are much more effective in providing ''selective'' benefits (see Olson, 1965) than others. Second, embodied in the underlying structure of the model is an (implicit) assumption that the lobby groups can commit to a particular contribution strategy. In the context of a one shot game, seeing why these promises is kept is hard, but, of course, in a dynamic context, reputational considerations may enforce them.

[2]For surveys of other models of endogenous policy formation, see, e.g. Hillman (1989); Rodrik (1995); Potters and van Winden (1996).

Third, the underlying electoral process is unspecified, and, accordingly, it is unclear why the incumbent government cares about campaign contributions.[3]

We organize the rest of the paper as follows. In Section 2, we describe the formal model. In Section 3, we analyse the political equilibrium and illustrate the principle of political internalization when lobby groups have multiple goals. In Section 4, we consider the case of functionally specialized lobby groups. In Section 5, we provide some concluding remarks.

2. The model

2.1. The economy

Consider a small open economy with $n+1$ competitive sectors of production, $k=0,1,\ldots,n$. Good 0 is numeraire. The international prices of the n non-numeraire goods are p_k^*. The domestic consumer and producer prices are given by q_k and p_k, respectively. Production in the numeraire section takes place by means of a CRS technology using only labour as input. Consequently, profit maximization and mobility of labour across sectors pin down the wage rate of the economy at $w=1$. Moreover, in the numeraire sector, firms do not pollute.

In the remaining n sectors, firms use three inputs: Labour, l_k, industry specific capital in fixed supply, K_k, and raw materials, r_k. A standard neoclassical production function with CRS describes technology. Raw materials can be thought of as either energy inputs, such as crude oil or coal, traded at a world market with a (common) world market price, z^*, or it can be thought of as environmental goods such as clean water. In the latter case $z^*>0$ refers to an exogenously given duty on water[4] or to the cost of extracting water from the subsoil. The use of raw materials has an external effect that does harm to the consumers of the economy. We refer to this as emission. We denote emission from sector k as e_k, and assume that $e_k=h_k(r_k)$, $h_r^k>0$, $h_{r,r}^k\geq 0$.[5] That is, emission is increasing in the use of raw materials at a non-decreasing rate. If r_k is energy inputs, we can think of e_k as emission of smoke (e.g. SO_2), and if r_k is clean water, we can think of e_k as waste water. Each firm is a price taker and supplies its output to a competitive market. With no spillover between prices in different sectors, profit maximization leads to the following restricted profit functions: $\pi^k(p_k, w, z_k)$, where z_k is the domestic

[3]See Grossman and Helpman (1996) for a recent model that is explicit about the relationship between electoral competition and lobby groups that provide campaign money.

[4]Our specification cannot accommodate environmental goods that are free ($z^*=0$) due to discontinuities in the profit function. Accordingly, to avoid difficulties, we restrict attention to inputs that have a positive market price ($z^*>0$), and assume that p_k^* and z^* are sufficiently large to avoid non-positive prices in equilibrium.

[5]We use f_j^i as generic notation for the partial derivative of function f^i with respect to argument j.

price of raw materials in sector k. π^k is strictly convex and has the derivative property, i.e., $\partial\pi^k/\partial p_k = x^k(p_k, w, z_k)$ and $\partial\pi^k/\partial z_k = -r^k(p_k, w, z_k)$, where x^k is firm k's supply function, and r^k is firm k's demand for raw materials. We notice that each firm can respond to environmental policy either by holding output constant while changing the input mix, i.e., by substituting to a cleaner technology, or by fixing the input mix while scaling production down.

The economy has N identical consumers. Each consumer derives utility from consumption of the $n+1$ goods and disutility from the total level of emission, $E = \Sigma_{k=1}^{n} e_k$. Hence, emission is assumed to be perfectly mixed in the sense that each consumer does not care about the distribution of emission across firms; only the total level of emission matters. Utility is quasi-linear and additively separable: $U^h = c_0 + \Sigma_{k=1}^{n} u(c_k) - g(E),\ u' > 0,\ u'' < 0,\ g' > 0,\ g'' \geq 0$. Each consumer receives income from three sources. First, she supplies, inelastically, her endowment of labour, l_h, to the competitive labour market, and receives the wage income wl_h. Second, she owns a share, $s_{k,h}$, of specific capital in sector k. To simplify, we assume that each individual holds capital claims 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. Third, each consumer receives $1/N$ of any government revenue, $R(\mathbf{p},\mathbf{q},\mathbf{z})$, as a lump sum transfer. From utility maximization subject to income, I, domestic consumer prices, $\mathbf{q}$, and emission, E, we derive the demand, $d^k(q_k)$, for the n non-numeraire goods. The residual determines the demand for the numeraire good: $d^0(\mathbf{q}) = I - \Sigma_{k=1}^{n} q_k d^k(q_k)$. We assume that $d^0(\mathbf{q}) > 0\ \forall q_k$ such that the wage rate is well-defined. Now, we can write the indirect utility of consumer h as:

$$V^h(\mathbf{p},\mathbf{q},\mathbf{z}) = l_h + \sum_{k=1}^{n} s_{k,h}\pi^k(p_k,z_k) + \tfrac{1}{N}R(\mathbf{p},\mathbf{q},\mathbf{z}) + \sum_{k=1}^{n} u(d^k(q_k)) - \sum_{k=1}^{n} q_k d^k(q_k) - g\left(\sum_{k=1}^{n} h^k(r^k(p_k,z_k))\right). \tag{1}$$

Add the indirect utilities up to get the following social welfare function:

$$W(\mathbf{p},\mathbf{q},\mathbf{z}) = l + \sum_{k=1}^{n} \pi^k(p_k,z_k) + R(\mathbf{p},\mathbf{q},\mathbf{z}) + N\left[\sum_{k=1}^{n} u(d^k(q_k)) - \sum_{k=1}^{n} q_k d^k(q_k)\right] - Ng\left(\sum_{k=1}^{n} h^k(r^k(p_k,z_k))\right). \tag{2}$$

2.2. The political process

The incumbent government chooses environmental policy. To this end, it has access to two environmental policy instruments: output and input taxes-cum-subsidies. The idea is that the government can decide to tax either production, and,

thereby, presumably, via the resulting contraction of output, reduce emission, or it can tax the source of the externality (raw materials) directly. Notice that, due to the functional relationship between e_k and r_k, taxation of emission and raw materials amounts to the same thing. Accordingly, we can, if emission is measurable, think of a raw material tax as a pollution tax. The net revenue from production and raw material taxes-cum-subsidies is given as:

$$R(\mathbf{p},\mathbf{z}) = \sum_{k=1}^{n} (p_k^* - p_k)x^k(p_k,z_k) + \sum_{k=1}^{n} (z_k - z^*)r^k(p_k,z_k). \tag{3}$$

We assume that the government pursues its own goals. It cares about a mixture of political contributions and social welfare. What we have in mind is a democratically elected government that during a term in office collects campaign contributions that will become handy in a later, un-modelled election. The objective function of the government is given as:

$$G(\mathbf{p},\mathbf{z}) = \theta W(\mathbf{p},\mathbf{z}) + \sum_{j=1}^{m} C^j(\mathbf{p},\mathbf{z}),$$

where $C^j(.)$ is the contribution from lobby group j, m is the total number of lobby groups and $\theta \geq 0$ is the weight that the government attributes to social welfare.

It is well-known that the internal organization of lobby groups is a complex matter (see, e.g. Olson, 1965). We assume that some agents for unspecified reasons overcome the free rider problem and organize lobby groups that offer campaign contributions to the government in exchange for environmental policy, while others do not. This is a crucial assumption because it is the presence of unorganized citizens that introduce an inefficiency in an otherwise socially efficient equilibrium. In Section 3, we assume that the owners of specific capital in a subset of the n industries organize lobby groups. Let $j=1$ to m be the organized sectors, while sectors with index $j=m+1$ to n remain unorganized. The key point is that each lobby group represents the preferences of its membership (e.g. the median member) sincerely, and, accordingly, has multiple goals. In particular, each lobby group cares about industry profit (to the extent that members hold stocks), environmental damage (to the extent that members are harmed by emission) and transfers from the government. Let the number of members of lobby group j be N_j. Then, from Eq. (1), we derive the gross welfare function of lobby group j:

$$W^j(\mathbf{p},\mathbf{z}) = l_j + \pi^j(p_j,z_j) + s_j R(\mathbf{p},\mathbf{z}) + s_j N\left[\sum_{k=1}^{n} u(d^k(q_k)) - \sum_{k=1}^{n} q_k d^k(q_k)\right] - s_j N g\left(\sum_{k=1}^{n} h^k(r^k(p_k,z_k))\right), \tag{5}$$

where s_j is the share of the total population organized in lobby group j (N_j/N). The fact that each lobby group cares about the harm that emission does to its own constituency has important implications for the political internalization of the

externality. In particular, it implies that each lobby group trades off the achievement of high profits with environmental protection before it enters the competitive political process. In Section 4, we consider the case of functionally specialized lobby groups in which the internalization solely arises from competition between ideologically motivated lobby groups. To be specific, we assume that a subset of the n industries organizes a producer lobby group that only cares about industry profit, and that a subset of the citizens, the environmentalists, organizes a green lobby group that only cares about the environment.

3. Environmental policy and lobby groups with multiple goals

3.1. The Pigouvian solution

As a benchmark, suppose that the government is benevolent in the sense that it does not care about campaign contributions. The government then chooses its environmental policy to maximize social welfare. Showing that the benevolent government would never use production taxes to correct the externality is straight forward. Instead as predicted by Bhagwati (1971), the socially optimal policy is to go directly to the source of the externality. The Pigouvian tax imposed on sector k is implicitly defined by $\overline{t}_k^r = Ng_E h_r^k$, and, hence, reflects the social marginal damage of emission from sector k. We notice that using a uniform raw material tax is not socially optimal.

3.2. Environmental policy in a political equilibrium

The relationship between the government (agent) and the m lobby groups (principals) is modelled as a common agency of politics. At a political equilibrium, environmental policy, $\{\mathbf{p}, \mathbf{z}\}$, and campaign contributions, $\{C^j(p_j, z_j)\}$, are determined as a subgame perfect Nash Equilibrium (see Bernheim and Whinston, 1986) of the following two stage game. In stage one, each lobby group determines its political contribution as a function of policy, taking the contribution schedules of the other lobby groups and the anticipated political optimization of the government in stage two as given. The result is a menu of optimal political contributions that is contingent on $\mathbf{p}$ and $\mathbf{z}$: $C^j(\mathbf{p}, \mathbf{z})$. In the second stage, the government, taking the contribution schedules as given, chooses the optimal policy, and collects the contributions from the lobby groups.

The derivation of the equilibrium in differentiable strategies follows Grossman and Helpman (1994); Dixit (1996) and Fredriksson (1997) closely and is left out. Instead, we, for ease of exposition, assume that the contribution schedules are globally truthful, i.e., the political contribution schedule of a lobby group everywhere reflects the true preference of the lobby group. So, $C^j(\mathbf{p}, \mathbf{z})$ is equal to the gross welfare function, W^j, less a constant. The constant distributes the rent

between the government and lobby group j.[6] The assumption of global truthfulness implies that the (politically) optimal policy vector can be derived as the solution to the following problem: $\max_{p,z\in\mathbb{R}_+} \theta W(\mathbf{p},\mathbf{z}) + \Sigma_{j=1}^{m} W^j(\mathbf{p},\mathbf{z})$. Let I_k be a dummy variable that takes on the value of one if industry j is organized and zero if not, and let $s_L = \Sigma_{j=1}^{m} s_j$. Then, we can write the first order conditions as follows:

$$\begin{aligned} p_k:\ & (\theta + s_L)(p_k^* - p_k)\pi_{p,p}^k - (\theta + s_L)\pi_{z,p}^k((z_k - z^*) - Ng_E h_r^k) \\ & + (I_k - s_L)x^k(p_k,z_k) = 0, \\ z_k:\ & (\theta + s_L)(p_k^* - p_k)\pi_{z,p}^k - (\theta + s_L)\pi_{z,z}^k((z_k - z^*) - Ng_E h_r^k) \\ & - (I_k - s_L)r^k(p_k,z_k) = 0. \end{aligned} \tag{6}$$

Solve the first order conditions to get an implicit solution for the politically optimal production and raw material tax-cum-subsidy scheme:

$$t_k^x = (p_k^* - p_k) = \frac{\pi_{z,z}^k(I_k - s_L)x^k(p_k,z_k)}{(\theta + s_L)\Delta_k} + \frac{\pi_{p,z}^k(I_k - s_L)r^k(p_k,z_k)}{(\theta + s_L)\Delta_k}, \tag{7}$$

$$\begin{aligned} t_k^r &= (z_k - z^*) \\ &= Ng_E h_r^k(p_k,z_k) + \frac{\pi_{p,p}^k(I_k - s_L)r^k(p_k,z_k)}{(\theta + s_L)\Delta_k} + \frac{\pi_{z,p}^k(I_k - s_L)x^k(p_k,z_k)}{(\theta + s_L)\Delta_k}, \end{aligned} \tag{8}$$

where $\Delta_k = (\pi_{z,p}^k)^2 - \pi_{z,z}^k\pi_{p,p}^k < 0$, $\pi_{p,p}^k > 0$ and $\pi_{z,z}^k > 0$ because the profit function is strictly convex. The sign of $\pi_{p,z}^k = \pi_{z,p}^k$ is determined by the profit spillover between the two environmental instruments, and is related to the underlying technology. Recall that $\pi_{p,z}^k = -r_p^k = x_z^k$. Therefore, $\pi_{p,z}^k > 0$ implies that an increase in the price of good k, which leads to an expansion of the production of that good, decreases the demand for raw materials from firms in sector k. While standard assumptions about technology do not rule this scenario out, we do find it reasonable to focus on the more intuitive case in which an expansion of production leads to an increase in the demand of all input factors, including raw materials. Hence, we assume that $\pi_{p,z}^k \leq 0$ for the rest of the paper.

From Eq. (7) and Eq. (8), we observe immediately that only the tax on the externality generating activity is used to correct for the external effect. Hence, we have a *political economy version of Bhagwati's principle of targeting*: the competitive political process internalizes the externality by means of the most efficient instrument, i.e., the one that aims directly at the source. This is because the equilibrium is efficient from the point of view of the lobby groups and the

[6] Since the lobby groups' and the government's objective functions are linear in the political contributions, equilibrium policy can be characterized independently of the distribution of equilibrium contributions.

government. That is, each lobby group and the government have a common interest in maximizing the surplus of the bilateral agency relationship in which they enter. So, since raw material taxation is the most efficient mean to internalize the externality, no lobby group would, based on environmental concerns alone, lobby in favour of other distortions. We refer to the first term of Eq. (8) as the environmental adjustment. We notice that the environmental adjustment depends on the Pigouvian adjustment $\bar{t}_k^r(p_k, z_k) = Ng_E h_r^k(p_k, z_k)$.[7]

Proposition 1. *(Political Internalization of Externalities).*

The price of the externality generating activity reflects the full Pigouvian adjustment.

The extent to which the political process internalizes the externality depends on a trade off between the environmental gain and the distortionary cost of taxation. On the one hand, the total concern about the environment, arising from the government's concern about the social damage of emission (θ) and the lobby groups' concern about the environmental damage incurred by organized citizens (s_L), tends to push t_k^r up above $\bar{t}_k^r$. On the other hand, taxing the externality generating activity distorts the demand for raw materials. This concern enters the political trade off to the extent that the government (θ) *and* the lobby groups (s_L) care about government revenue, and tends to push t_k^r down below $\bar{t}_k^r$. Since we assume that $R(z_k, p_k)$ is distributed proportionally across all citizens, the two concerns are given equal weight in the balancing consideration, and, consequently, the environmental adjustment corresponds to the full Pigouvian adjustment. Moreover, the adjustment is independent of whether or not the government cares about social welfare per se. That is, political internalization takes place even if $\theta = 0$, and, accordingly, solely arises from the Coasian element of mobilization of the affected parties.

It is, however, obvious that proposition 1 is sensitive to the exogenously given transfer rule that the government employs to return revenue to the citizens. In particular, if the government gives the lobby groups more (less) than their population share, then the environmental adjustment is smaller (greater) than the Pigouvian adjustment. This is because the concern for the distortionary cost of taxation is given more (less) weight than the environmental concern. However, it is generally true that the environmental adjustment depends on the Pigouvian adjustment no matter how we specify the transfer rule.

The political equilibrium does not replicate the social optimum unless all sectors are organized. This is because the lobby groups have income distributional as well as environmental objectives, and are successful in distributing income from unorganized citizens towards themselves. It is of interest to consider in more detail how the politically optimal tax-cum-subsidy structure deviates from the social

[7]Notice that $\bar{t}_k^r(p_k, z_k)$ is written as a function of p_k and z_k. Only if $\bar{t}_k^r(p_k, z_k)$ is evaluated at the appropriate tax vector, it corresponds to the socially optimal Pigouvian tax.

optimum. First, we see immediately from Eq. (7) that the domestic producer price in each sector deviates from the world market price. If $\pi^k_{p,z}=0$,[8] this corresponds closely to the results of Grossman and Helpman (1994); Dixit (1996). Organized industries ($I_k=1$) receive a production subsidy to boost profits. Unorganized sectors ($I_k=0$) are taxed because each lobby group bids for taxes in all other industries to generate more tax revenue, part of which the government transfers to organized citizens. If $\pi^k_{p,z}<0$, an additional effect arises from the spillover between the two policy instruments. The spillover effect dampens the profit/revenue effect. The intuition is straight forward. If sector k' is organized, then the lobby group bids for a lower subsidy ($p_{k'}\downarrow$) because doing so decrease the marginal cost of raw material taxation. If section k' is unorganized, lobby groups from organized sectors bid for a lower production tax ($p_{k'}\uparrow$) because it induces firms from industry k' to increase their use of raw materials ($r^{k'}_p>0$), and, thereby, it generates more tax revenue to be distributed (partly) among organized citizens. Of course, since the spillover effect works against the profit/revenue effect, it could, in principle, be dominating. A necessary and sufficient condition under which the government subsidises (taxes) production from an organized (unorganized) sector is (C1) $|\epsilon(r^k, z)|>|\epsilon(x^k, z)$, where $\epsilon(\gamma, \beta)$ is the elasticity of γ with respect to β.

Second, we notice that the income distributional considerations also distort the politically optimal tax on the externality generating activity (raw materials). To be specific, we have:

Proposition 2. *Let $g_{E,E}=h^k_{r,r}=0$. If and only if (C2) $\gamma(x^k,p)>\epsilon(r^k,p)$, then t^r_k is below (above) the Pigouvian tax if k is an organized (unorganized) sector.*

Proof. The assumption that $g_{E,E}=h^k_{r,r}=0$ implies that $\bar{t}^r_k=Ng_Eh^k_r$ is independent of z_k and p_k. So, the proposition follows from a simple manipulation of Eq. (8) □

First, consider an organized industry, i.e., $I_k=1$. If C2 is satisfied, then each lobby group asks for an environmental discount to its own industry. Two effects are involved. The first effect is the ''cost saving'' effect (the second term of Eq. (8)), arising from the fact that a tax on raw materials (or emission) increases the cost of production. Although the government gives back part of the revenue to the membership of the lobby group, each lobby group asks the government for a discount to its own industry. The second effect is the spillover effect (the third term of Eq. (8)). As $\pi^k_{p,z}$ is non-positive, the spillover effect dampens the cost saving effect. That is, the lobby groups, *ceteris paribus*, ask for a higher tax in their own industry because doing so decreases the marginal cost of production

[8]In discussing the sign and size of the various derivatives of the profit function, it is understood that they are evaluated at the equilibrium price vector.

taxation. If the spillover effect is small relative to the cost saving effect, *the government might subsidise the externality generating activity*, even though taxation is warranted from a social point of view. On the other hand, if the spillover effect is sufficiently large so that C2 fails to hold true, then the income distributional motive adds to the environmentally motivated tax.

Next, consider an unorganized industry, i.e., $I_k = 0$. For revenue reasons, the lobby groups bid for a high tax on the use of raw materials (see the second term of Eq. (8)) in unorganized. Again, the spillover effect dampens the revenue effect. This is because a decrease in the domestic price of raw materials in sector k induces (unorganized) firms to produce more ($x_z^k < 0$), thereby generating more revenue from production taxation. However, unless C2 fails to hold, we see that the competitive political process transfers a disproportionate share of the abatement cost to unorganized sectors. So, due to revenue seeking, a substantial beggar-thy-neighbour element is involved in environmental lobbying.

How likely are conditions C1 and C2 to hold? Under the assumption that $\pi^k_{z,p} \leq 0$ in all sectors, the two conditions, basically, state that own price effects are greater than cross effects. For instance, C2 holds true if supply is more responsive to changes in the domestic price of output than the demand for raw materials. Overall, we find conditions C1 and C2 plausible, and conclude that the spillover effect is likely to dampen the various direct income distributional effects, but unlikely to dominate them.

From an environmental point of view, it is of interest to consider if political distortions lead to inefficiently high emission. The distribution of emission across industries, of course, depends on the equilibrium tax-cum-subsidy structure via the relationship $e_k = h_k(r^k(p_k, z_k))$, but also, directly, on $\pi^k_{p,z} = r^k_p \leq 0$. Hence, in general, making any predictions is difficult. However, suppose that C1 and C2 hold true. If sector k is organized (unorganized), then emission is greater (lower) than the Pigouvian level. That is, due to the environmental discount, organized sectors discharge too much, while unorganized sectors because of the ''extra'' tax bill discharge too little. Of course, the overall level of emission is, most likely, inefficient. However, the direction of the inefficiency depends (among many other features of the model) on the distribution of organized and unorganized sectors, and is, accordingly, ambiguous.

3.3. A uniform tax on the externality generating activity

In the previous analysis, we allowed the government to use a differentiated tax-cum-subsidy scheme, and, in the resulting political equilibrium, the government would, indeed, use this option. Thinking of t^r_k as a pollution tax, the use of differentiated taxes-cum-subsidies seems natural only if the environmental authorities can measure emission from the various sources. However, in many circumstances, the use of differentiated taxes-cum-subsidies is difficult because of measurement problems. Suppose, for instance, that raw materials are easily traded

among industries (oil, coal etc.), and it is impossible to measure (and tax) emission. An arbitrage argument suggests that the sector with the lowest domestic price buys raw materials from the market with the purpose of reselling them to other sectors, thereby circumventing the differentiated structure of taxation. Accordingly, it is of interest to analyse the political equilibrium under the restriction that only a uniform raw material tax-cum-subsidy can be used. To simplify the discussion, we assume that $\pi^k_{p,z}=0$. The politically optimal uniform raw material tax-cum-subsidy scheme is implicitly given as:

$$\begin{aligned} t^r &= (\mathbf{z}-\mathbf{z}^*) \\ &= \frac{Ng_E\sum_{k=1}^{n} h^k_r \pi^k_{z,z}}{\sum_{k=1}^{n}\pi^k_{z,z}} + \frac{s_L\sum_{k=m+1}^{n} r^k(p_k,z_k) - (1-s_L)\sum_{k=1}^{m} r^k(p_k,z_k)}{(\theta+s_L)\sum_{k=1}^{n}\pi^k_{z,z}}. \end{aligned} \tag{9}$$

First, the environmental adjustment cannot be targeted at each sector, and, so, it cannot reproduce the Pigouvian adjustment. Accordingly, the environmental adjustment is a weighted average of the social marginal damage of emission from the n sectors. Next, the last term reflects a trade off between the net cost savings on the raw material bill in organized sectors and the extra tax revenue extracted from unorganized sectors. Whether the environmental adjustment is reinforced or not depends on the proportion of organized citizens, s_L, and the total demand for raw materials from organized and unorganized sectors, respectively. To summarize, since the lobby groups cannot contingent their political contributions on a sector-specific policy, redistributing income across industries becomes harder. This reduces the beggar-thy-neighbour element of environmental lobbying. On the other hand, with a uniform raw material tax-cum-subsidy, the government cannot target the environmental adjustment to correct for the sector-specific marginal social damage of emission.

4. Environmental policy and 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. To see this, suppose that capital owners in a subset of the n industries, $j=1$ to m, organize a producer lobby group that is only concerned with profit, $\pi_j(p_j, z_j)$, $j=1,\ldots,m$. Moreover, a group of environmentalists organizes a (green) lobby group to advocate environmental protection. The objective function of the green lobby group is given as $W_E=K-s_E g(\Sigma^n_{k=1} h^k(r^k(p_k, z_k)))$, where s_E is the proportion of environmentalists in the population

and K is a constant. For $\theta>0$, the politically optimal tax structure is implicitly given by:

$$t_k^x = (p_k^* - p_k) = -\frac{I_k x^k(p_k,z_k)}{\theta \pi^k_{p,p}},$$

$$t_k^r = (z_k - z^*) = \frac{(\theta + s_E)}{\theta}\bar{t}_k^r(p_k,z_k) - \frac{I_k r^k(p_k,z_k)}{\theta \pi^k_{z,z}}. \tag{10}$$

We have, to simplify the discussion and without loss of any essential insights, imposed the restriction that $\pi^k_{p,z}=0$. With functionally specialized lobby groups, the political internalization solely arises from competition between the various groups who get their voice represented in the political process. We notice that the environmental adjustment of the price of the externality generating activity is always larger than the corresponding Pigouvian adjustment. This is because both the government and the green lobby group care about environmental damage, while only the government, via its concern for social welfare, cares about the distortionary effect of the pollution tax.

Functional specialization also has implications for the income distributional motive for environmental lobbying. The producer lobby groups accept the environmental adjustment supported by the environmentalists in exchange for a production subsidy and an environmental discount. In unorganized sectors, the only intervention is the environmental adjustment. This is because firms in these industries have no producer lobby group to ask for subsidies, and because producer lobby groups do not care about generating government revenue. The principal difference between the case in which lobby groups have multiple goals and the case in which they are functionally specialized is the transfer motive. Functionally specialized groups have no such motive, which, in turn, reduces the beggar-thy-neighbour element of environmental lobbying, and leads to an environmental adjustment that is always larger than the Pigouvian adjustment.

5. Concluding remarks

This paper points out that competition between lobby groups is an important source of internalization of externalities. Both the competitive political process itself and the fact that some lobby groups adjust their economic objectives to reflect environmental concerns contribute to the political internalization. We show, in a common agency of politics, that the Pigouvian adjustment is reflected in the price structure despite the various political distortions. However, since not everybody is organized in a lobby group and lobby groups advance income distributional goals at the expense of efficiency considerations, the politically optimal environmental policy does not replicate the set of Pigouvian taxes needed

to achieve social optimum. In particular, under plausible assumptions about the spillover between the two policy instruments, organized sectors get a discount at the expense of unorganized sectors, which are taxed at inefficiently high rates.

An important discussion in environmental economics concerns the choice of policy instrument. Our analysis generalizes the principle of targeting to distorted political markets: the environmental adjustment is targeted at the source of the externality. This is because the lobby groups and the government agree to pick the more efficient instrument to correct for the externality, or in general, as pointed out by Dixit et al. (1997), favour more efficient instruments to less efficient ones.[9] This is, in turn, driven by the fact that the focus of the common agency model of politics is on the efficient equilibrium of Bernheim and Whinston (1986) menu auction. In contrast, Buchanan and Tullock (1975) base their discussion of pollution taxation versus direct regulation on a disagreement between the government and producer-interests. The government prefers the tax because enforcing direct control requires a high enforcement cost. The lobby group prefers direct regulation because it serves as a coordination device that creates short-run monopoly rents. The disagreement is resolved by arguing that the small, concentrated group of producers is much more efficient in influencing policymaking than the large group of ordinary citizens (who, presumably, supports a pollution tax because of the revenue), and, so, in the political equilibrium, direct controls are chosen despite the fact that the pollution tax is more efficient.

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[9]Becker (1983, 1985) also argues that competition among lobby groups leads to efficient methods of taxation. In his model lobby groups unanimously prefer more efficient methods because of a lower dead weight loss.

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