Lobbying against environmental regulation vs. lobbying for loopholes

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ABSTRACT: We analyze the determinants of environmental policy when two industry lobbies can seek a laxer policy that would apply to both industries and loophole lobbying that provides benefits specific to one industry. We determine the properties of the lobbying equilibrium, including the resulting emissions level. In many cases, higher effectiveness of loophole lobbying is detrimental for industries and beneficial for environmental quality, as it exacerbates the free-rider problem in the provision of general lobbying by inducing industries to turn towards loophole lobbying.

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1 Introduction

Representatives of polluting industries usually want environmental policy to be lax, but have different preferences about how to distribute the burden of any legally required emissions reduction among them. For instance, economy-wide energy taxes can be designed in different ways, with various kinds of sectoral exemptions. A case in point is the German eco tax, which contains many explicit or implicit loopholes for particular industries.[1] At first glance, the freedom of policy makers to grant such loopholes would appear to be disadvantageous for the environment. However, this is less clear if environmental policy is endogenously influenced by the lobbying activities of interest groups.

We shall propose that, when an environmental policy can be implemented in many different ways with different distributional implications for the affected industries, the political-influence activities of each industry will be diverted from resisting regulation as such towards lobbying for industry-specific loopholes. As a result, when there is considerable scope for loopholes, the equilibrium policy may be stricter than when there is not. Intuitively, greater scope for loopholes means that the incentive for free-riding on other industry lobbies in the resistance to regulation is larger.

We make this argument more precise in a model with two lobbies, each of which represents an industry. An industry lobby has two instruments to influence the tax it faces, *general lobbying* and *loophole lobbying*. These activities translate into industry taxes by means of a policy formation function with the following properties. First, total general lobbying of the two industries determines a base level of the tax that is an upper bound for both industry taxes; higher general lobbying corresponds to lower taxes. By definition, therefore, general lobbying is a public good from the point of view of

[1] Apart from a preferential treatment of the manufacturing industry as opposed to the service industry, the Eco Tax contains a complicated set of special regulations which amount to loopholes for specific sectors (Friedrich-Ebert-Stiftung, 1999, Chapt. 1, Tab. 1, Bundesumweltministerium, 2002).

the industries. As such, it is prone to underprovision. Second, by definition, loophole lobbying of an industry only reduces the tax for this particular industry, as it reflects efforts to gain tax exemptions. The effect of loophole lobbying on the other industry is assumed to be at best neutral, but typically negative: The more the other industry lobbies for favors, the more effort is required by a group to obtain similar concessions.[2]

Each industry is imperfectly competitive with constant marginal costs, including an output-dependent environmental tax. The industry profit, gross of lobbying costs, is a decreasing function of marginal costs. Therefore, an industry's gross profits are an increasing function of total general lobbying and of its own loophole lobbying, but a non-increasing function of the competing group's loophole lobbying. Industry lobbies simultaneously choose general lobbying and loophole lobbying expenditures so as to maximize industry profits, net of lobbying expenditures. An exogenous parameter θ measures the scope for loophole lobbying. For *given levels* of each type of lobbying, higher values of this parameter mean that loopholes for each industry increase and thus taxes decrease. Also, the absolute value of the marginal effect of loophole lobbying on taxes is higher.

In this setting, our central point is as follows: Because of strategic interactions, greater scope for loopholes may lead to an equilibrium that involves higher environmental taxes and less pollution. Industry groups that both expect loophole lobbying to be effective will tend to focus on this kind of activity, rather than on general lobbying against environmental regulation. The tendency for underprovision of general lobbying as a public good is enhanced by the existence of the alternative, loophole lobbying. Thus, somewhat paradoxically, greater effectiveness of loophole lobbying may well be detrimental to lobbyists - and beneficial to the environment.

[2]Both types of lobbying can take various forms: information campaigns, legal or illegal contribution payments, or the promise of cooperation in other policy areas. Very roughly, one would expect loophole lobbying to be more secretive: The smaller the group in society whose interests the lobbying activities represents, the less likely it is that public information campaigns will receive much public attention.

Lobbyists are aware of the conflict between general lobbying and loophole lobbying. For instance, in a recent press release the German Auto Industry Association VDA demanded a common stance of the VDA and the Logistics Industry Association BGL against a heavy vehicle charge rather than "speculation about possible distributive effects of the charge" (VDA 2002). More generally, industry associations are typically members of higher level associations that deal with general lobbying. For instance, the press releases of the German BDI usually concern general topics like climate policy, water policy or even abstract concepts such as the precautionary principle.[3] The associations can therefore be interpreted as an institutional answer to the problem of excessive loophole lobbying.[4]

Our paper has some bearing on a central question of positive environmental economics, namely, what kind of regulation is likely to emerge as the outcome of the political process? This question has at least two dimensions. First, what kind of instruments are likely to be used to improve environmental quality?[5] Second, why are some environmental effects regulated more vigorously than others?[6] For this kind of application, we interpret our model more broadly. Though we formulate the most specific version of our model as a game between industry lobbies resisting environmental taxes, most of our results also hold for a more general reduced form. In the more general interpretation, the environmental regulation can take the form of a standard

[3] http://www.bdi-online.de

[4] On a related note, Aidt (1997) argues that, in the context of endogenous trade policy, centralized cooperation of lobbies can overcome externality problems. Such problems have been shown to lead to inefficient lobbying equilibria in a non-cooperative setting by Magee et al. (1989), implying excessive protectionism.

[5] A large literature investigates this question. For surveys, see Keohane et al. (2000) and Dijkstra (1999).

[6] For instance, why have emissions such as lead, carbon monoxide, NOx and many water pollutants been eliminated or reduced successfully in many industrial countries, whereas in other policy areas (CO2, benzene, noise, species extinction) very little has changed despite considerable public attention?

rather than a tax.[7] Also, lobbies need not necessarily be representatives of different industries. Each "lobby" could, for instance, correspond to an individual firm. We would then speak of loophole lobbying when firms seek more lenient treatment than other firms within the same industry. General lobbying would then refer to activities directed against regulation of the entire industry.[8]

In such a more general interpretation, we can compare how lobbying behavior is likely to depend on the problem under consideration. For instance, we can compare the lobbying behavior of a group of industry associations facing an eco tax with the lobbying behavior of a group of automobile firms facing highway speed regulation. For automobile firms as the anti-regulation lobbyists, there is little scope for loophole lobbying. A speed limit may be more or less rigid, but that is about as far as regulatory flexibility goes: An individual exemption from speed limits for Audi, BMW, Mercedes or Porsche would be inconceivable, so loophole lobbying in this area cannot achieve much. Thus, if firms spend effort on lobbying, it must necessarily be directed towards preventing regulation as such rather than towards obtaining loopholes. Even though general lobbying is still subject to free riding, this problem is mitigated by the absence of the alternative, loophole lobbying.[9] It is therefore not surprising that lobbying of the German auto industry against

[7] See Polk and Schmutzler (2003) for details.

[8] Also, one could consider cases where loophole lobbying is not directed at obtaining exemptions from some general regulation; it could also be about resisting specific regulations that only affect the particular lobbyist's group. In Germany, for instance, the food industry association BVE has engaged in campaigns against a mandatory deposit on beverage cans, against mandatory consumer information on food quality, and in favor of a more liberal treatment of genetic food.(see http://www.bve.de). The auto industry organisation VdA resisted a charge on heavy vehicles, highway speed regulations, and an obligation to take back old cars (see http://www.vda.de).

[9] Even so, some firms might prefer to devote less effort to general lobbying against speed regulation than others, simply because they have less to gain. All we are saying is that the members of the group of firms that do have strong preferences against speed regulation are compelled to resist the regulation as such rather than lobby for loopholes.

speed restrictions has been highly successful.[10]

Another application concerns the principle that emission standards must be non-discriminatory rather than differentiating across firms. By familiar textbook arguments, differentiation of standards has efficiency advantages similar to those of taxes or tradeable permits: By differentiating standards so as to equate the marginal costs of abatement, the total costs of achieving a target level of emissions can in principle be minimized. We suggest that, nevertheless, firms may prefer a legal environment where differentiated standards are prohibited: Without such differentiation, firms are aware that the only way to secure high emissions standards for themselves is to work towards the common goal of a lax uniform standard. If differentiation is allowed, there is scope for loophole lobbying, which distracts them from focussing on resisting regulation as such.

Though there is a considerable literature on endogenous environmental policy,[11] we are not aware of any paper on multi-dimensional lobbying against environmental regulation. However, Rodrik (1986) notes the asymmetry between tariffs and production subsidies that, from the perspective of firms in import-competing industries, the former are public goods, whereas the latter are not. Therefore, lobbying for tariffs and lobbying for subsidies correspond to our concepts of general lobbying and private lobbying, respectively.[12] Finally, the particular aspect of our model that the Nash equilibria of lobbying games may be inefficient for the interest groups under consideration has received considerable attention (see e.g. Magee et al., 1989).

The paper is organized as follows: Section 2 describes our general frame-

[10]We have little to say about why speed regulation was lax in Germany, but not in other countries. The composition of the German car industry and the resulting strength of lobbying incentives provide a likely (but trivial) explanation. Our approach allows the less trivial comparison of lobbying outcomes in situations without substantial differences in lobbying incentives.

[11]See Hahn (1990), Fredriksson (1997), Aidt (1998), Damania (1999).

[12]Bennedsen and Feldmann (2002) also analyze the choice between different types of lobbying activities. There, however, the lobbies choose between informational lobbying and contribution payments rather than general and loophole lobbying.

work. Section 3 presents comparative statics results under the assumption of a binding budget constraint. Section 4 extends the analysis to an unlimited budget. Section 5 concludes.

2 The framework

2.1 *General assumptions*

We analyze a game between two lobby groups $i = 1, 2$ where each group represents a polluting industry. Both industries are imperfectly competitive. For simplicity, firms in an industry have constant and identical marginal costs c^i. We make the following assumption:

Assumption 1 *Industry profits are a decreasing and convex function of marginal costs.*

The property of decreasing profits is very general.[13]

Marginal costs are affected by environmental policy towards industry i, which, for simplicity, is given by a tax t^i. Thus, if the pre-tax level of marginal costs is $\overline{c}$, after-tax levels are $\overline{c} + t^i$. Groups can lobby to influence environmental policy. The tax t^i for industry i depends on the overall tax level t and an industry-specific loophole l^i. To influence the overall tax, industries can engage in *general lobbying.* The amount spent on such activities by industry i is $g^i \geq 0$. The total tax level is a function of the total general

[13] The convexity property also holds in many circumstances, including the linear monopoly and the standard static linear oligopoly models: For instance, in the linear monopoly model with demand $x = a - p$, the second derivative of profits with respect to costs is $1/2 > 0$. Oligopoly examples include differentiated Bertrand and Cournot models as well as competition on the line. For a related discussion on the convexity of individual firm profits, see Athey and Schmutzler (2001). Industries with lower costs have high output and mark-up; for those industries the additional increase in mark-up resulting from further cost reductions is more valuable as it applies to a greater output, and, conversely, the additional increase in output is more valuable as the mark-up earned on each additional unit is higher.

lobbying effort, $g \equiv g^1 + g^2$. General lobbying efforts of both groups are thus perfect substitutes, so that groups provide a public good through general lobbying.[14] To influence the loophole, industries engage in *loophole lobbying,* $p^i \geq 0$, which, by definition, increases only the individual loophole. On the other hand, loophole lobbying of the competing group tends to reduce the own loophole.[15]

We also assume decreasing returns to lobbying. Summing up:

Assumption 2 *The industry-specific tax* t^i *is a function* $T^i = T^i\left(t\left(g\right), l^i\left(p^i, p^j\right)\right)$ *such that for* $i = 1, 2, j \neq i$

$$\begin{aligned} \frac{\partial T^i}{\partial t} &\geq 0;\ t_i^i \equiv \frac{\partial T^i}{\partial l^i} \leq 0;\ t_g \equiv \frac{dt}{dg} \leq 0;\ l_i^i \equiv \frac{\partial l^i}{\partial p^i} \geq 0; \\ l_j^i &\equiv \frac{\partial l^i}{\partial p^j} \leq 0;\ t_{gg} \equiv \frac{\partial t^2}{\left(\partial g\right)^2} \geq 0;\ l_{ii}^i = \frac{\partial^2 l^i}{\left(\partial p^i\right)^2} \leq 0 \end{aligned} \tag{1}$$

Industry profits, gross of lobbying costs, are therefore

$$\Pi^i\left(p^i, p^j, g\right) = \pi^i\left(\overline{c} + T^i\left(t\left(g\right), l^i\left(p^i, p^j\right)\right)\right). \tag{2}$$

We consider two specifications of the tax function. For *additive tax functions,*

$$T^i(t, l^i) = t^i = t - l^i.$$[16]

For *multiplicative tax functions,*

$$T^i(t, l^i) = t^i = t\left(1 - l^i\right), \text{ where } l^i \in [0, 1].$$

In the former case, a loophole is interpreted as an absolute reduction in the tax level; in the latter case, it corresponds to a percentage reduction. Neither case appears more or less plausible on a priori grounds. As we shall see, some results will hold for both cases, whereas for others, the strategic effects differ for additive and multiplicative functions.

We introduce the following measure of the effectivity of loophole lobbying.

[14]Obviously, general lobbying is only a public good for the set of firms, not for other groups of society.

[15]Intuitively, groups compete for favors by legislators. If the competing group j spends much on loophole lobbying, group i will have to exert more effort to obtain such favors.

Definition 1 *$\theta \in \Re$ parameterizes the effectivity of loophole lobbying if it enters the function l^i and satisfies the following properties:*

$$\frac{\partial l^i}{\partial \theta} \geq 0; \frac{\partial^2 l^i}{\partial p^i \partial \theta} > 0 \text{ for } i = 1, 2; \frac{\partial^2 l^i}{\partial p^j \partial \theta} \leq 0 \text{ for } i = 1, 2, j \neq i. \tag{3}$$

Our preferred interpretation of θ is that discussed in the introduction: In some situations, there is less scope for loopholes than in others because the regulator has little flexibility in the design of the instruments. Such cases are characterized by a low θ, whereas θ is high when regulatory flexibility is high.

3 Binding budget constraints

In this section, we assume that the budget of each lobby has a fixed size, which we normalize to one, so that $p^i = 1 - g^i$. This assumption is more than just a convenient simplification: In some contexts, the budget will be hard to change. An industry lobby finances its campaigns from the contributions of its members, which, at least in the short term may be fixed. We thus consider the game with $p^i \in [0, 1]$ and objective functions

$$\widetilde{\pi}^i \left(p^i, p^j; \theta\right) = \pi^i \left(\overline{c} + T^i \left(t \left(2 - p^i - p^j\right) - l^i \left(p^i, p^j; \theta\right)\right)\right).$$

We are interested in comparative statics with respect to the effectiveness parameter θ. To carry out these comparative statics and to guarantee local stability, we introduce the next assumption.

Assumption 3 *$\widetilde{\pi}^i \left(p^i, p^j; \theta\right)$ is twice continuously differentiable with respect to all variables and satisfies $\widetilde{\pi}^i_{ii} < 0$, and $\widetilde{\pi}^i_{ii}\widetilde{\pi}^j_{jj} - \widetilde{\pi}^i_{ij}\widetilde{\pi}^j_{ji} > 0$.*[17]

This game has a Nash equilibrium in pure strategies, (p^1_*, p^2_*). For an interior equilibrium, straightforward calculations yield:

$$\frac{dp^i}{d\theta} = \frac{-\widetilde{\pi}^i_{i\theta}\widetilde{\pi}^j_{jj} + \widetilde{\pi}^j_{j\theta}\widetilde{\pi}^i_{ij}}{\widetilde{\pi}^i_{ii}\widetilde{\pi}^j_{jj} - \widetilde{\pi}^i_{ij}\widetilde{\pi}^j_{ji}} \tag{4}$$

[17]For both types of tax functions, the condition that $\widetilde{\pi}^i_{ii} < 0$ is an implication of (1).

$$\frac{dg^i}{d\theta} = \frac{dp^i}{d\theta} \tag{5}$$

Intuitively, a higher θ should increase loophole lobbying: Simple calculations show that Assumption 2 and Definition 1 imply that $\widetilde{\pi}^i_{i\theta} \geq 0$ for both specifications of the tax function.[18] Thus, a higher θ increases the marginal returns to increasing p^i, so that, other things equal, more loophole lobbying should result. The following proposition confirms this intuition, using a symmetry assumption.

Proposition 1 *Suppose both lobbies have identical payoff functions. If the equilibrium is symmetric before and after an increase in θ, loophole lobbying must increase with θ.*

Proof. (i) Suppose loophole lobbying efforts are strategic complements at the equilibrium ($\widetilde{\pi}^i_{ij} \geq 0$). The result then follows directly from (4) and (5), using $\widetilde{\pi}^i_{i\theta} \geq 0$ and $\widetilde{\pi}^i_{ii} \leq 0$ by concavity.

(ii) Now suppose lobbying efforts are strategic substitutes at the equilibrium ($\widetilde{\pi}^i_{ij} \leq 0$). Denote the equilibrium for the initial parameter value θ_* as $(p^1_*, p^2_*) = (p_*, p_*)$. Then $\frac{\partial \pi^i}{\partial p^i}(p^1_*, p^2_*; \theta_*) = 0$ for $i = 1, 2$. As θ_* increases to θ_{**}, $\frac{\partial \pi^i}{\partial p^i}(p_*, p_*, \theta_{**}) > 0$, because $\widetilde{\pi}^i_{i\theta} \geq 0$. Now suppose the new equilibrium $p^1_{**} = p^2_{**} = p_{**}$ satisfies $p_{**} < p_*$. Then, by concavity of π^i in p_i and $\widetilde{\pi}^i_{ij} \leq 0$,

$$\frac{\partial \pi^i}{\partial p^i}(p_{**}, p_{**}, \theta_{**}) \geq \frac{\partial \pi^i}{\partial p^i}(p_*, p_*, \theta_{**}) > 0,$$

so that the first-order condition for an equilibrium is violated at p_{**}. ■

The intuition depends on whether loophole lobbying efforts are strategic complements or strategic substitutes. Under the assumptions made so far, both cases are possible.[19] With strategic complements, the direct effects of θ

[18] Using the envelope theorem, $\widetilde{\pi}^i_{i\theta} = -\pi^i_c l^i_{i\theta}$ for additive tax functions, whereas $\widetilde{\pi}^i_{i\theta} = -\pi^i_{cc} t_g l^i_\theta l^i_i - \pi^i_c l^i_{i\theta} t$ for multiplicative tax functions.

[19] For the additive tax function, $\widetilde{\pi}^i_{ij} = \pi^i_c \left(t_{gg} - l^i_{ij}\right) > 0$ if and only if $t_{gg} - l^i_{ij} < 0$. As $t_{gg} > 0$, loophole lobbying activities will only be strategic complements in $\widetilde{\pi}^i_{ij}$ if they are sufficiently strong complements in l^i, i.e., l^i_{ij} is positive and sufficiently large.

on p^1 and p^2 are mutually reinforcing: The direct effect of θ on p^1 induces a positive effect on p^2 and vice versa. With strategic substitutes, the indirect effects of loophole lobbying are more complex: an increase in loophole lobbying by one industry induces decreasing loophole lobbying by the other one. Thus, the positive direct effects of θ on p^1 and p^2 tend to offset each other. However, under the symmetry assumption the direct effect dominates. Thus, as the effectivity of loophole lobbying increases, groups engage in more loophole lobbying under the symmetry condition.[20] Through this strategic effect, an increase in the effectiveness of loophole lobbying benefits the environment:

Proposition 2 *With fixed budgets, emissions decrease with θ for symmetric equilibria if l^i_θ is sufficiently small at the equilibrium.*

To understand this result, write equilibrium lobbying efforts as $p^*(\theta)$ and define the individual equilibrium tax level for each industry i as

$$T^*(\theta) \equiv T\left(t^*(2-2p^*(\theta)), l^i(p^*(\theta), p^*(\theta), \theta)\right).$$

Emissions are decreasing in θ if the following expression is negative:[21]

$$\frac{dT^*}{d\theta} = \frac{\partial T}{\partial l^i} l^i_j p^*_\theta - \frac{\partial T}{\partial t} t^*_g p^*_\theta + \frac{\partial T}{\partial l^i} l^i_\theta.$$

The last term on the right-hand-side reflects the direct effect of higher θ on loopholes and taxes: absent any behavioral changes, taxes fall as θ increases. The remaining terms capture the strategic effects of the increase in loophole lobbying ($p^*_\theta > 0$). These strategic effects work towards an increase of taxes. $\frac{\partial T}{\partial l^i} l^i_j p^*_\theta$ is non-positive, capturing the negative effect of increasing loophole lobbying on opponent loopholes as $l^i_j \leq 0$. Then consider $-\frac{\partial T}{\partial t} t^*_g p^*_\theta$. Because

[20]Potentially, the indirect effect may lead to a reduction in loophole lobbying by one industry. However, such a counterintuitive result requires substantial asymmetries between lobby groups; see Polk and Schmutzler (2003) for details. There, we also show that, for asymmetric groups, at least one group increases loophole lobbying.

[21]The calculation uses the envelope theorem; which guarantees that an additonal term $\left(\frac{\partial T}{\partial l^i} l^i_i - \frac{\partial T}{\partial t} t_g\right) p^*_\theta$ cancels out.

of the fixed budget, more loophole lobbying means less general lobbying, which increases taxes for both industries. Again, this increases taxes.

The net effect of a change of θ on taxes consists of the direct effect, $\frac{\partial T}{\partial l^i} l^i_\theta$, which is beneficial for industries, and the increasing negative externalities that groups exert on each other. Clearly, if the direct effect is very strong, higher θ and lower taxes will coincide. Whenever the indirect effects dominate, however, taxes will increase as groups engage more heavily in loophole lobbying.[22]

Proposition 2 is our central result for the fixed budget case. It indicates that an increasing importance of loopholes tends to be beneficial for the environment, at least in a symmetric situation. If lobbying becomes more important, industries focus on lobbying activities that tend to be ineffective.[23]

4 Unlimited budgets

4.1 *Generalities*

With an unlimited budget, an increase in loophole lobbying no longer decreases general lobbying automatically: In principle, industries can increase both types of lobbying when θ rises. Therefore, we do not obtain straightforward comparative statics results without further restrictions. Nevertheless, we can gain considerable insight into the strategic interactions.

With unlimited budgets, (p^i, g^i) can be chosen from $[0, \infty) \times [0, \infty)$. [24]

[22]Note that, in $\frac{dT^*}{d\theta}$, p^*_θ can be substituted for using (4). Doing so, clarifies in particular, that a small value of l^i_θ does not automatically imply a small value of p^*_θ.

[23]In Polk and Schmutzler (2003), we showed that the above results also hold when the instrument under consideration is a pollution standard rather than a tax.

[24]As long as there is an upper bound B to the industry profit for arbitrary lobbying choices, a pure-strategy Nash equilibrium $\left(p^1_*, p^2_*, g^1_*, g^2_*,\right)$ of the game exists. Strategies with $p^i + g^i > B$ are strictly dominated, so that, to find a Nash equilibrium, one can assume compact strategy spaces and the proof follows from Prop. 8.D.3 in Mas-Colell et al. (1995).

Further, for simplicity, we apply the following *symmetry restriction*:

$$\pi^1 = \pi^2 \equiv \pi;\ l^1 = l^2 \equiv l; p_*^1 = p_*^2;\ g_*^1 = g_*^2. \tag{SR}$$

In Appendix 7.1, we use (SR) to derive the formulas for $\frac{dp^{i*}}{d\theta}$ and $\frac{dg^{i*}}{d\theta}$ ((8) and (9)). We now apply these formulas to show that there are no substantial differences between additive and multiplicative tax functions. We shall confine ourselves to the results and the intuition; the proofs are in the appendix.

4.2 *Additive tax functions*

4.2.1 *Single player decisions*

The effects of increasing θ on one industry for given behavior of the other one are unambiguous for additive tax functions.

Proposition 3 *For unlimited budget and additive tax functions, the best responses* $p^i\left(p^j, g^j; \theta\right)$ *and* $g^i\left(p^j, g^j; \theta\right)$ *are increasing in* θ *for* $j = 1, 2, j \neq i$.

Proof. See Appendix 7.2.1. ■

The intuition has three ingredients. First, the marginal benefit from increasing loophole lobbying, $\Pi^i_{p^i}$, is increasing in θ ($\Pi^i_{p^i\theta} > 0$). This is so for two reasons. Most obviously, higher θ increases the effectiveness l^i_i of loophole lobbying at generating loopholes. Thus, the cost reduction from increasing p^i becomes larger as θ increases. In addition, as the profit function π^i is convex in c^i, the value of a cost reduction of any given size is higher the lower costs initially are. In particular, because costs are low if θ is high ($l^i_\theta > 0$), any further cost reduction from loophole lobbying is more valuable the higher θ is. Second, the marginal benefit from increasing general lobbying, $\Pi^i_{g^i}$, is increasing in θ (($\Pi^i_{g^i\theta} > 0$)). Again, this reflects the convexity of profits in marginal costs: As $l^i_\theta > 0$, costs are low when θ is high. Reducing them further by carrying out general lobbying is therefore more valuable. Third, for additive functions, general lobbying and loophole lobbying are complements in the objective function of each lobby ($\Pi^i_{p^i g^i} \geq 0$). Again, this follows from the convexity argument: The higher general lobbying (and therefore the lower the tax), the higher the gain from the additional tax reduction that comes from loophole lobbying.

Combining these three ingredients, we find that higher θ has direct positive effects on general and loophole lobbying, and that these effects are mutually reinforcing. Thus, *for fixed behavior of the other group*, a lobby will increase both types of expenditures.

4.2.2 *Strategic interaction*

To understand the strategic interactions between players, we need to know how changes in one group's action affect the other group's lobbying returns.

Proposition 4 *For additive tax functions and unlimited budgets, $i, j = 1, 2$ and $i \neq j$:*
(i) $\Pi^i_{p^i g^j} \geq 0$ *(ii)* $\Pi^i_{g^i g^j} \leq 0$ *(iii)* $\Pi^i_{g^i p^j} \leq 0$
(iv) $\Pi^i_{p^i p^j}$ *is ambiguous; but* $\Pi^i_{p^i p^j} < 0$ *if* $l^i_{ij} < 0$.

Results (i) and (ii) are analogous to the earlier result that $\Pi^i_{p^i g^i} \geq 0$ and the concavity requirement that $\Pi^i_{g^i g^i} \leq 0$.[25] Intuitively, (iii) follows because higher loophole lobbying of the competitor reduces the own loophole and thus increases own costs. The value of the cost reduction from general lobbying (t_g) is thus reduced by convexity of $\pi^i(c_i)$. As to (iv), higher loophole lobbying of j increases i's marginal costs $\left(l^i_j < 0\right)$ and thus decreases incentives for cost reduction from general lobbying by convexity of $\pi^i(c_i)$. As long as $l^i_{ij} < 0$, lobbying is also less effective when the competitor engages in more private lobbying, reinforcing the idea that lobbying decisions are strategic substitutes. On the other hand, the precise nature of the loophole function $l^i(p^i, p^j; \theta)$ depends on unmodeled aspects of the political process, so that we are reluctant to claim that the sign of l^i_{ij} is necessarily negative.

[25] g^i and g^j enter Π^i only via $g = g^i + g^j$, so that $\Pi^i_{p^i g^j} = \Pi^i_{p^i g^i}$ and $\Pi^i_{g^i g^i} = \Pi^i_{g^i g^j}$.

Figure 1 summarizes our findings for additive tax functions. The connected lines correspond to positive interactions (complementarities between the variables); dashed lines correspond to negative interactions.

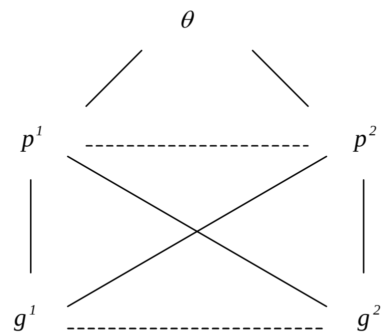

Figure 1: Interactions between lobbying decisions – the additive case

4.2.3 *Comparative statics results*

For additive tax functions, the result that loophole lobbying crowds out general lobbying breaks down quite generally.

Proposition 5 *(i) Consider the unlimited budget case with additive lobbying functions. Under symmetry, the equilibrium levels of general lobbying and loophole lobbying move into the same direction as θ increases.*
(ii) Suppose further that $\Pi^i_{p^i p^j} < 0$ or $\Pi^i_{p^i p^j} < \left|\Pi^i_{p^i p^i}\right|$. Then general lobbying and loophole lobbying both increase as a result of the increase in θ.

The proposition reflects the idea that general lobbying and loophole lobbying are complementary activities in the objective function of each industry (see Subsection 4.2.1).[26] The additional condition in (ii) ensures that strategic effects do not undermine this intuition.

4.3 *Multiplicative tax functions*

4.3.1 *Single player decisions*

For multiplicative tax functions, increasing θ has less straightforward effects, unless $\alpha^i \equiv \frac{-\pi_c^i}{\pi_{cc}^i}$ is large. This requirement has a particularly transparent interpretation if the industries are monopolies with linear demand functions $x = a - p$. Then $\alpha^i = a - c^i$ is the standard market size parameter.[27] As Appendix 7.3.1 shows, large α^i is also consistent with the required second order conditions.

Proposition 6 *For multiplicative taxes, if* $\alpha^i > (1 - l^i)\,t$*,* $p^i(p^j, g^j; \theta)$ *is increasing in* θ *and* $g^i(p^j, g^j; \theta)$ *is decreasing in* θ *for* $i, j = 1, 2, j \neq i$.

The result shows that, as for the binding budget constraint, loophole lobbying crowds out general lobbying, at least for a large α^i. Intuitively, the result follows if $\Pi^i_{p^i\theta} \geq 0$, $\Pi^i_{g^i\theta} \leq 0$ and $\Pi^i_{p^ig^i} \leq 0$: By $\Pi^i_{p^i\theta} \geq 0$, the direct effect of a higher θ is an increase in p^i and a reduction in g^i. With $\Pi^i_{p^ig^i} \leq 0$, higher loophole lobbying makes general lobbying less attractive, and vice versa. Thus, the positive effect of θ on p^i and the negative effect on g^i are mutually reinforcing.

However, while $\Pi^i_{p^i\theta} \geq 0$ holds by definition, $\Pi^i_{g^i\theta} > 0$ and $\Pi^i_{p^ig^i} > 0$ are both possible if we do not impose the restriction on α^i. In both cases, this reflects convexity of $\pi^i(c_i)$.[28] Nevertheless, there are forces towards $\Pi^i_{g^i\theta} \leq 0$ and $\Pi^i_{p^ig^i} \leq 0$: As to $\Pi^i_{g^i\theta}$, high θ corresponds to large loopholes by $l^i_\theta > 0$,

[26] The additional condition in part (ii) is fairly weak. For instance, from Proposition 4, $\Pi^i_{p^ip^j} < 0$ for $l^i_{ij} < 0$. The weaker requirement that $\Pi^i_{p^ip^j} < \left|\Pi^i_{p^ip^i}\right|$ still holds when $l^i_i < \left|l^i_j\right|$ and $\left|l^i_{ii}\right| < l^i_{ij}$.

[27] Recall that, for linear monopolies, $\pi(c_i) = (a - c_i)^2/4$.

[28] If θ or p^i increases, costs fall. This increases the value of further cost reductions from increasing g^i.

so that the tax reduction from increasing general lobbying is relatively low. As to $\Pi^i_{p^i g^i} \leq 0$, for industries that engage heavily in loophole lobbying and therefore have large loopholes, the effect of general lobbying on t^i is small. In Appendix 7.3.2, we show that, in spite of the potential countereffects, $\Pi^i_{g^i \theta} \leq 0$ and $\Pi^i_{p^i g^i} \leq 0$ if $\alpha^i > (1 - l^i)\, t$.

4.3.2 *Strategic interactions*

Again, we summarize our observations on the relevant second derivatives.

Proposition 7 $\Pi^i_{p^i p^j}, \Pi^i_{g^i p^j}$ *and* $\Pi^i_{p^i g^j}$ *have ambiguous signs. If* α^i *is sufficiently large,* $\Pi^i_{g^i p^j} \geq 0$ *and* $\Pi^i_{p^i g^j} \leq 0$*. If, in addition,* $l^i_{ij} < 0$*, then* $\Pi^i_{p^i p^j} < 0$*.*

We confine ourselves to identifying the sources of ambiguity; details are given in the Appendix.

(i) $\Pi^i_{p^i p^j}$: Cost reductions from loophole lobbying of any given size are worth less when costs are high (for instance, because of intense lobbying by the competitor). However, unless $l^i_{ij} < 0$, the size of the cost reduction will be higher when competing lobbies lobby more intensively.

(ii) $\Pi^i_{g^i p^j}$: Increases in loophole lobbying of the competitor reduce the own loophole and therefore increase the effect of general lobbying on the net tax $t\,(1 - l^i)$. However, by the convexity argument, higher loophole lobbying of competitors increases own costs and thus reduces the gains from cost reductions of any given size.

(iii) $\Pi^i_{p^i g^j}$: This corresponds to the discussion of $\Pi^i_{p^i g^i}$ in Section 4.3.1.

Figure 3 summarizes Proposition 7, if α^i is large and $l^i_{ij} < 0$.[29] The figure illustrates that the direct positive effects of increasing θ on loophole lobbying induce negative effects on general lobbying of both players.

[29] The interpretation of the lines is analogous to Figure 2.

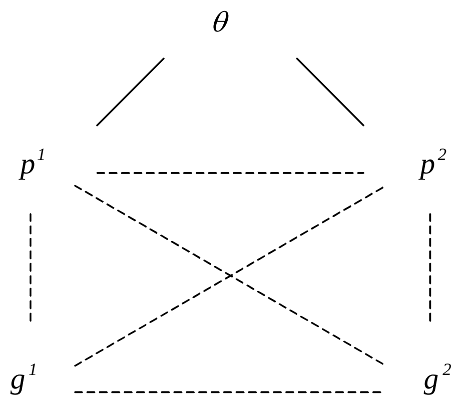

Figure 3: Interactions between lobbying decisions – the multiplicative case

4.3.3 *Comparative statics*

The crowding-out result holds under reasonable conditions.

Proposition 8 *Suppose that* $\Pi^i_{g^i\theta} \leq 0, \Pi^i_{p^ip^j} \leq 0$ *and* $\left|\Pi^i_{g^ip^j}\right| \leq \Pi^i_{g^ip^i}$. *Then, for multiplicative tax functions, loophole lobbying increases and general lobbying decreases as* θ *increases.*

The condition $\left|\Pi^i_{g^ip^j}\right| \leq \Pi^i_{g^ip^i}$ is extremely weak: It holds as long as $l^i_i > \left|l^i_j\right|$ at the equilibrium, that is, own lobbying has a stronger effect on loopholes than the other industry's lobbying.

Crucially, the two types of lobbying are complements for additive tax functions, but substitutes for multiplicative tax functions. Thus, general lobbying and loophole lobbying tend to move together for additive tax functions, whereas they move in different directions for multiplicative tax functions.

4.3.4 *Effects on emissions*

We now ask under which circumstances an increase in θ increases taxes and thereby decreases pollution. Taxes will fall when general lobbying and loophole lobbying both increase, which tends to be true for additive tax functions. We therefore confine ourselves to multiplicative tax functions where increases of loophole lobbying and decreases in general lobbying often coincide. We obtain the following simple condition for a decrease in emissions.

Proposition 9 *Denote the symmetric equilibrium lobbying efforts as* $p(\theta)$ *and* $g(\theta)$*, respectively. Then taxes for each industry are an increasing function* $T(\theta)$ *of* θ *if* $(2g_\theta + p_\theta) l_i^i + l_j^i p_\theta + l_\theta^i < 0$.

As in Section 3, emissions can only be increasing if l_θ^i is not to large.

5 Conclusions

We have shown that when environmental regulation can be carried out in ways that have different distributional implications for affected groups, the outcome may be stricter regulation. In such situations, groups place greater emphasis on loophole lobbying than on general lobbying. If the lobbyists face a binding budget constraint, an increase in loophole lobbying reduces general lobbying, the net effect of which is a reduction in emissions. The results are less clear-cut for unlimited budgets, but under reasonable conditions loophole lobbying can still crowd out general lobbying.

There is a caveat to our argument. We have focussed entirely on distributional concerns among anti-environmental lobbies. Symmetric issues arise with pro-environmental lobbies. Environmental lobbies will favor environmental regulations but may disagree on the type. For instance, suppose two industries operate in different regions that produce global pollutants, so that the positive effects of environmental policy affect the regions in the same way. Suppose, however, that each region bears the costs of local pollution reduction. Suppose further that there is one environmental lobby in each region. Then, though both lobbies want global pollution reduction, they prefer the reduction to take place in the other region.[30] Thus, regional environmental

[30]This assumes that local environmental groups also care about the economic well being

lobbies might reduce general lobbying for environmental policy, because they also put some effort into lobbying for letting the other region bear a greater part of the costs of pollution reduction.[31]

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7 Appendix: Unlimited budgets

7.1 *Generalities*

The first-order conditions for maximizing (2), net of lobbying costs, is

$$\pi_c^i \frac{\partial T^i}{\partial l^i} l_i^i = 1 = \pi_c^i \frac{\partial T^i}{\partial t} t_g. \tag{6}$$

The second-order conditions are:

$$\pi_{p^i p^i}^i \leq 0; \pi_{g^i g^i}^i \leq 0; \pi_{p^i p^i}^i \pi_{g^i g^i}^i - \left(\pi_{g^i p^i}^i\right)^2 \geq 0. \tag{7}$$

(SR) implies:

$$\begin{aligned} \Pi_{p^1 p^2}^1 &= \Pi_{p^2 p^1}^2;\ \Pi_{g^1 p^2}^1 = \Pi_{g^2 p^1}^2;\ \Pi_{g^1 g^1}^1 = \Pi_{g^1 g^2}^1 = \Pi_{g^2 g^1}^2 = \Pi_{g^2 g^2}^2 \\ \Pi_{g^1 p^1}^1 &= \Pi_{p^1 g^2}^1 = \Pi_{p^1 g^2}^1 = \Pi_{p^2 g^1}^2 = \Pi_{p^2 g^2}^2 = \Pi_{g^2 p^2}^2;\ \Pi_{p^1 \theta}^1 = \Pi_{p^2 \theta}^2;\ \Pi_{g^1 \theta}^1 = \Pi_{g^2 \theta}^2 \end{aligned}$$

of their own region to some extent. See also the distinction in Hillman and Ursprung (1994) regarding "greens" and "supergreens".

[31] Although our model is formulated as a lobbying game against environmental regulation, the general idea is potentially relevant for policy games where interest groups have a common aim but compete regarding the distribution of benefits. Such situations also arise with respect to output taxation in general and to redistribution among the members of federal states.

Using these conditions together with the implicit function theorem,

$$\frac{dp^{i*}}{d\theta} = \frac{\Pi^i_{g^i g^i}\Pi^i_{p^i\theta} - \Pi^i_{g^i\theta}\Pi^i_{p^i g^i}}{\left(\Pi^i_{p^i g^i}\right)^2 + \Pi^i_{p^i g^i}\Pi^i_{g^i p^j} - \Pi^i_{g^i g^i}\Pi^i_{p^i p^i} - \Pi^i_{g^i g^i}\Pi^i_{p^i p^j}} \tag{8}$$

$$\frac{dg^{i*}}{d\theta} = \frac{1}{2}\frac{\Pi^i_{p^i p^i}\Pi^i_{g^i\theta} + \Pi^i_{p^i p^j}\Pi^i_{g^i\theta} - \Pi^i_{p^i\theta}\Pi^i_{p^i g^i} - \Pi^i_{p^i\theta}\Pi^i_{g^i p^j}}{\left(\Pi^i_{p^i g^i}\right)^2 + \Pi^i_{p^i g^i}\Pi^i_{g^i p^j} - \Pi^i_{g^i g^i}\Pi^i_{p^i p^i} - \Pi^i_{g^i g^i}\Pi^i_{p^i p^j}} \tag{9}$$

7.2 *Additive tax functions*

7.2.1 *Proof of Proposition 3*

Straightforward calculations show that

$$\Pi^i_{p^i\theta} = -\pi^i_c l^i_{i\theta} + \pi^i_{cc} l^i_\theta l^i_i \geq 0;\ \Pi^i_{g^i\theta} = -\pi^i_{cc} l^i_\theta t_g \geq 0;\ \Pi^i_{p^i g^i} = -\pi^i_{cc} t_g l^i_i \geq 0 \tag{10}$$

Thus, Π^i is supermodular in p^i, g^i and has increasing differences in $(p^i, g^i; \theta)$. By Proposition 5 in Milgrom and Roberts (1990), the optimal values of p^i and g^i are therefore increasing in θ.

7.2.2 *Proof of Proposition 4*

(i) and (ii) follow from $\Pi^i_{p^i g^i} \geq 0$ (condition (10)) and the second order condition $\Pi^i_{g^i g^i} \leq 0$. (iii) follows from

$$\Pi^i_{g^i p^j} = -\pi^i_{cc} l^i_j t_g.$$

(iv) uses

$$\Pi^i_{p^i p^j} = -\pi^i_c l^i_{ij} + \pi^i_{cc} l^i_j l^i_i.$$

7.2.3 *Proof of Proposition 5*

(i) At the equilibrium $(p^1_*, p^2_*, g^1_*, g^2_*) = (p_*, p_*, g_*, g_*)$ for $\theta = \theta_*, \frac{\partial \pi^i}{\partial p^i} = 0$. Because $\Pi^i_{p^i\theta} \geq 0$ and $\Pi^i_{g^i\theta} \geq 0$, $\frac{\partial \pi^i}{\partial p^i} > 0$ and $\frac{\partial \pi^i}{\partial g^i} > 0$ for (p_*, p_*, g_*, g_*) if $\theta = \theta_{**} > \theta_*$. Now suppose the equilibrium level of p_i corresponding to θ_{**}

is $p_{**} < p_*$. Then, from $\Pi^i_{p^ip^i} < 0$ and $\Pi^i_{p^ip^j} < 0$, $\frac{\partial \pi^i}{\partial p^i} > 0$ for $(p_{**}, p_{**}, g_*, g_*)$ if $\theta = \theta_{**}$. Now suppose further that $g_{**} > g_*$. Then using $\Pi^i_{p^ig} > 0$, $\frac{\partial \pi^i}{\partial p^i} > 0$ for $(p_{**}, p_{**}, g_{**}, g_{**})$ if $\theta = \theta_{**}$, contradicting the best-response condition.
(ii) The numerator of (8) is negative. Using (7), (10) and the additional condition in (ii), the denominator is also negative. Therefore loophole lobbying increases. By (i), general lobbying also increases.

7.3 *Multiplicative tax functions*

7.3.1 *Preliminaries*

For *multiplicative tax functions*, (6) implies that

$$tl^i_i = -\left(1 - l^i\right) t_g. \tag{11}$$

Using this condition, (7) becomes

$$-\pi^i_c t l^i_{ii} + \pi^i_{cc} \left(tl^i_i\right)^2 \leq 0;\ \pi^i_c t_{gg} \left(1 - l^i\right) + \pi^i_{cc} \left(tl^i_i\right)^2 \leq 0$$
$$\left(-\pi^i_{cc} \left(tl^i_i\right)^2 + \pi^i_c t_g l^i_i\right)^2 \leq \left(-\pi^i_c t l^i_{ii} + \pi^i_{cc} \left(tl^i_i\right)^2\right) \left(\pi^i_c t_{gg} \left(1 - l^i\right) + \pi^i_{cc} \left(tl^i_i\right)^2\right).$$

The first two second-order conditions hold when α^i is sufficiently large.

7.3.2 *Proof of proposition 6*

(i) $\Pi^i_{p^i\theta} \geq 0$ still holds, as

$$\Pi^i_{p^i\theta} = -\pi^i_c t l^i_{i\theta} + \pi^i_{cc} l^i_\theta t^2 l^i_i. \tag{12}$$

(ii) $\Pi^i_{g^i\theta}$ can be positive or negative:

$$\Pi^i_{g^i\theta} = -\pi^i_c t_g l^i_\theta - \pi^i_{cc} t \cdot l^i_\theta \cdot t_g \left(1 - l^i\right) \tag{13}$$

The first term is negative; the second term is positive. From (11),

$$\Pi^i_{g^i\theta} = \frac{\pi^i_c t l^i_i l^i_\theta}{(1 - l^i)} + \pi^i_{cc} t^2 l^i_i l^i_\theta \tag{14}$$

Hence, $\Pi^i_{g^i\theta} < 0$ if and only if $\alpha^i > (1 - l^i)\, t$.

(iii) Next,

$$\Pi^i_{p^i g^i} = -\pi^i_c t_g l^i_i - \pi^i_{cc} \left(t_g \left(1 - l^i\right) t l^i_i\right). \tag{15}$$

The first term is negative; the second term is positive. Similar arguments as in (ii) show that $\Pi^i_{p^i g^i} < 0$ if $\alpha^i > (1 - l^i) \cdot t$.

Therefore, if $\alpha^i > (1 - l^i)\, t$, $\Pi^i_{g^i\theta} \leq 0$, $\Pi^i_{p^i g^i} \leq 0$ and $\Pi^i_{p^i\theta} \geq 0$. Thus, Π^i is supermodular in p^i and $-g^i$ and has increasing differences in $(p^i, -g^i\,; \theta)$. Theorem 5 in Milgrom and Roberts (1990) now yields the result.

7.3.3 *Proof of Proposition 7*

The results follows from

(i) $\Pi^i_{p^i p^j} = -\pi^i_c t l^i_{ij} + \pi^i_{cc} t^2 l^i_i l^i_j$

(ii) $\Pi^i_{g^i p^j} = -\pi^i_c t_g l^i_j - \pi^i_{cc} l^i_j t\,(1 - l^i)\, t_g$

(iii) $\Pi^i_{p^i g^j} = \Pi^i_{p^i g^i}$.

7.3.4 *Proof of Propositon 8*

The proof follows directly from (8) and (9), using (7), $\Pi^i_{p^i\theta} \geq 0; \Pi^i_{g^i p^i} \leq 0$ and the conditions of the proposition. The conditions $\Pi^i_{g^i\theta} < 0, \Pi^i_{p^i p^j} \leq 0$ have already been shown to hold when α^i is sufficiently large and $l^i_{ij} < 0$.

7.3.5 *Proof of Proposition 9*

From $T(\theta) = t\,(2g\,(\theta))\,(1 - l^i\,(p\,(\theta)\,, p\,(\theta)\,, \theta))$, we obtain:

$$\frac{dT}{d\theta} = 2t_g \left(1 - l^i\right) g_\theta - t \left(l^i_i p_\theta + l^i_j p_\theta + l^i_\theta\right).$$

Using (11) the statement immediately follows.

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