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Environmental legislation and the impact of lobbying activities

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ENVIRONMENTAL LEGISLATION AND THE IMPACT
OF LOBBYING ACTIVITIES

by Elga Bartsch, Michael Rauscher, Ingo Thomas
März 1993

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Abstract: The paper is concerned with effects of lobbying activities by political pressure groups that wish to affect environmental legislation. Two interest groups are considered, environmentalists on the one hand and a polluters' lobby on the other. These two groups can influence the environmental policy in two ways. First, they support those political parties that promise to implement their favoured kind of environmental regulation. This support has an impact on election probabilities and, therefore, on the environmental policy measures implemented by the new government. The second way of influencing political decisions is to exert pressure on an existing government. These two approaches are used in the paper to address the questions of how environmental quality is affected by lobbying activities and how large the resource waste due to lobbying is.

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1. Introduction

The standard normative analysis in environmental economics focuses on the optimal use of the environment assuming that the optimal emission level or alternatively the emission tax rate is set by a benevolent government. It is well known however from the public choice literature that we have to consider the possibility of government failure. The benevolent government theory has not been able to explain much of the public policy as it is perceived in reality, which often deviates from the socially desirable policy frequently proposed by environmental economists. Thus we have to look for other explanations of environmental policy making that take into account the political decision making process.

The aim of this paper is to show how lobbying activities affect environmental legislation both by the means of political support for different parties and by providing information for the government. In order to do so we use two different models. In the first one, lobbies influence the outcome of the electoral process in a two-party system in which the parties' political programmes are exogenously given. In the second model, we look at lobbying efforts that are devoted to influencing an existing government's environmental policy. In both models there are two lobbies: the industry and the greens both maximising their utility given the lobbying effort of the corresponding counter-lobby. Thus, the analysis will be carried out in a static Nash equilibrium framework.

Besides identifying the equilibria and the parameters they are influenced by, we are interested in two results that are at first glance counter-intuitive. On the one hand, it may be possible that interest groups harm themselves by increasing their lobbying effort. This may happen if an increase in lobbying of one interest group leads to more than proportional increase in lobbying of the other group. If such a strong encouragement effect is observed, lobbying by a pro-environment group may lead in fact to increased emissions. We specify conditions under which this will be the case as well circumstances under which we find the reverse result, that counter-lobbying may discourage the other lobby. On the other hand, an increase in the lobbying effort of one party may discourage the other party so much that total lobbying expenditure is reduced. Hence, an increase in lobbying incentives may reduce total lobbying activities and, consequently, the waste of resources that is due to lobbying. It will be shown that the second result is possible whereas the first is not - at least for the model specification chosen in this paper.

There is only rare theoretical literature on the political economy of environmental protection (a recent exception is Ursprung 1992)¹. Basically the few papers dealing with the political dimension of environmental economics from a theoretical point of view can be divided into three different categories. Papers in the rent-seeking tradition emphasise the distributive issues of environmental policy. In particular it is investigated how the choice of the policy instrument in order to ensure a certain environmental standard can be explained in terms of political economy. The credo of these papers is that the regulatory approach to environmental protection enables the emitting industry to extract a rent in contrast to price-based instruments as a pollution tax² (cf. the seminal paper by Buchanan, Tullock 1975, a more recent paper dealing with an open economy is the one by Hoekman, Leidy 1992). A second, completely different set of papers looks at the determination of the environmental standard in the political process, esp. in the voting procedure. The main conclusion is the underprovision of environmental protection both in a representative and a direct democracy (cf. Buchanan, Vanberg 1988). Finally, following the bureaucracy-models of Niskanen (1971) and others, the role of the environmental protection agency which has the power to implement legislation is analysed. Downing 1981 develops a model in which the environmental protection agency is subject to pressure of the emitting industry on one hand and a pro control environmental group on the other.

Deviations from the socially optimal allocation of resources are possible when lobbying activities are in the position to influence the political decision making process. This is caused by two different kinds of distortions. First, resources are directed away from productive activities and are spend on lobbying efforts instead. This causes a welfare loss³. Second, if interest groups are able to influence the policy, we will observe a bias in environmental policy. Public policy on pollution control is the result of a complex set of interactions among different lobbies (i. e., emitters, recipients) and the government. The result of these interactions will depend among other things on the relative strength of these lobbies. This paper, however, does not carry out an explicit normative analysis of the welfare costs involved by

¹ Empirical case studies however seem to be abound e.g. Crandall 1983, Maloney, McCormick 1982, Pashigian 1988.

² In our model, different environmental policy instruments are equivalent. If we assume in the case of emission taxation that the resulting revenue is redistributed to emitters in a lump sum fashion it does not make a difference if an emission standard or the corresponding tax rate is implemented.

³ The social costs of lobbying are subject to substantial literature. The general issue if rent-seeking constitutes a waste of resources at all or is simply a transfer of income is analysed by Brooks, Heijdra, 1987a; Varian 1989; Delorme, Snow 1990. Other papers dealing with environmental issues carry out a normative analysis of the optimal environmental policy when lobbying prevails. Lee 1988, and Lee, Wilson 1991 derive the optimal pollution tax when rent-seeking with respect to the revenue raised is taken into account. Brooks, Heijdra 1987b, extend the analysis by including second best considerations.

pressure group activities which would include lobbying costs as well as the suboptimal use of the environment induced by lobbying efforts. It is simply assumed (in accordance with most of the partial equilibrium rent-seeking literature) that lobbying expenditures constitute a waste of resources.

The model framework of political competition among pressure groups in the decision process on the allowable emission level used in this paper are closely related to the rent-seeking literature⁴. Most rent-seeking models neglect voting. This approach is chosen in our second model where lobbies attempt to influence the environmental policy made by the government. In contrast to the traditional rent-seeking models, the lobbies are not contesting for the rent directly but they use resources to affect public opinion (and the politicians' opinion in particular) concerning the severity of the environmental problem. The green lobby tends to exaggerate the environmental damage whereas the industry lobby belittle. The other model by contrast incorporates the election process. It is assumed that interest groups simply try to promote the electoral chance of their favoured candidate taking that candidate's policy position as fixed. The general case is discussed by Austen-Smith 1987. We portray the political support for candidates by using a contest-success function based on the classic rent-seeking approach of strategically interacting rent-seekers (cf. Tullock, 1980). In the electoral competition there, are two candidates with given environmental concerns. Political support takes place in form of campaign contributions. The probability of being elected is determined by the relative lobbying efforts. In this setting, lobbying has an effect solely on the relative likelihood of election of the competing candidates and only thereby affects the policy in a rather indirect manner⁵. In contrast, this model takes the policy platform in terms of the allowable quantity of emissions as exogenously given. The voters are not explicitly modelled in the election process. This assumption can be partially justified by the fact that voters are rationally uninformed. The lack of information gives rise to a discretionary power to politicians, who are no longer bound by voter preferences. We neglect the problem of pressure group formation in particular the free-rider problem involved in the voluntary provision of the group specific public good lobbying. For a rigorous analysis of the Olson problem see Pethig (1988).

The paper is organised as follows. The following section introduces the general model of interest group competition in the electoral process and shows how environmental policy is affected by lobbying activities. Section 3 introduces the optimising behaviour by the lobbyists. In section 4, the Nash

⁴ See Buchanan, Tollison, Tullock 1980, Rowley, Tollison and Tullock 1987

⁵ A more complex version of the model is discussed by Ursprung 1991, where candidates are assumed to maximise their probability of being elected via their policy pronouncement taking a Stackelberg leader position with regard to interest groups.

equilibrium of lobbying activities is investigated. Section 5 looks at the alternative model in which lobbies influence the government's policy. Some final remarks conclude the paper.

2. The political decision making process

Consider a model of electoral competition between two candidates or parties respectively. Each of them announces an exogenous policy platform in terms of the allowable emission level. The party with the higher environmental concern, called the green party, announces an emission level E^g whereas the more industry friendly party, called the industry party, announces a higher emission level $E^g + b$, $b > 0$. The probability of being elected is affected by campaign contributions of the respective interest group, where L denotes expenditures by the industry's interest group and L^* expenditures by the green interest group devoted to campaigning. The probability of winning the election depends on the contribution received by the corresponding interest group relative to the total amount spent on campaigning⁶. We introduce a parameter x , $x > 0$, which takes into account differing productivity of campaign contributions. If $x > 1$ the industrialists are more efficient in the electoral competition process. This implies that one monetary unit of lobbying expenditures by the industry lobby has a greater impact on the election probabilities than has a monetary unit of green lobbying expenditures. Vice versa, a value of $x < 1$ indicates a greater effectiveness of the green lobby. This difference may be due to voter preferences in favour of one party or the other as well as differing know-how in a politico-technical sense.⁷ If voter preferences are biased towards the green party, votes tend to be more expensive for the industry lobby ($x < 1$). If there is no lobbying activity at all, that is $L = L^* = 0$, the likelihood that the industry party is elected is $x/(1+x)$. This implies that if $x=1$ the unbiased probability of being elected is 0.5. Applying Tullock's terminology to this context, xL can be interpreted as the number of votes the industrial lobby can buy for an amount L . The price for votes is normed such that one monetary unit of green lobbying expenditures buys one green vote. Depending on the probability that the respective candidate is elected, the expected emission level⁸ is given by

⁶ This formulation follows the Tullock-Model of rent-seeking, where the probability of winning an exogenously given rent depends on the relative resource commitment, defined as the number of lottery tickets bought in relation to the total number of lottery tickets sold (cf. Tullock, 1980, p. 99).

⁷ In contrast to the bias introduced by Tullock 1980 indicating a different amount of lottery tickets a dollar can buy, we use a linear relationship, whereas Tullock uses an exponential function, which gives rise to the problem of increasing returns to scale.

⁸ All variables denote expected values.

$$(1) \quad E = \frac{L^*}{xL + L^*} E^g + \frac{xL}{xL + L^*} (E^g + b)$$

The expected emission level equals the weighted sum of the announced emissions levels, with weights given by the probability that the respective candidate will be elected. This can also be written as

$$(2) \quad E = E^g + \frac{xL}{xL + L^*} b$$

Differentiation of E with respect to L and L^* yields

$$(3) \quad \frac{dE}{dL} = \frac{x(xL + L^*) - x^2 L}{(xL + L^*)^2} b = \frac{xL^*}{(xL + L^*)^2} b > 0$$

$$(4) \quad \frac{dE}{dL^*} = \frac{-xL}{(xL + L^*)^2} b < 0$$

$$(5) \quad \frac{d^2 E}{dL^2} = \frac{-2x^2 L^*}{(xL + L^*)^3} b < 0$$

$$(6) \quad \frac{d^2 E}{dL^*{}^2} = \frac{2xL}{(xL + L^*)^3} b > 0$$

As one would expect, the direct impact of the industry's lobbying on expected emissions is positive and the direct impact of green lobbying is negative. The marginal impact on the emission level decreases (in absolute terms) as the level of lobbying increases. We find a positive but decreasing marginal impact for the industry lobby and a negative increasing impact at the margin for the greens.

The sign of the cross derivative, that indicates the indirect effect of a change in the marginal lobbying impact of the industrial lobby due to a change in the green interest group's effort and vice versa, is ambiguous.

$$(7) \quad \begin{aligned} \frac{d^2 E}{dL dL^*} &= \frac{x^2 L - xL^*}{(xL + L^*)^3} b \\ &> 0 \text{ if } L^* < xL \\ &= 0 \text{ if } L^* = xL \\ &< 0 \text{ if } L^* > xL \end{aligned}$$

The change in the marginal impact on E does not only depend on the absolute level of lobbying expenditures of both groups, but also on the efficiency parameter x . Therefore we can interpret the three cases that have to be distinguished as follows: There is no indirect effect of green campaigning on emissions via changes in the rivals lobbying effectiveness, when the number of votes bought is equal ($L^* = xL$). The effect is positive if the majority of votes bought are in favour of the industry's party ($L^* < xL$). This implies that the marginal productivity of industrial lobbying is increased by green lobbying and so is the industry's lobbying effort. This amplification effect might lead to the paradox result that emissions in fact rise when green lobbying increases. By contrast, if more green votes have been bought ($L^* > xL$), the emitter's lobby tends to be discouraged by green lobbying and this positively affects the environmental quality. This is intuitively evident, because this is *ceteris paribus* more likely if $x < 1$, meaning that the green lobby is more efficient.

3. Interest Group Competition in a Two-Party Model

The two interest groups already introduced in the general model can be characterised as follows: The industry lobby maximises its profits which are given by the difference of the value of output y and the amount spent on lobbying activities L in order to affect the election result. Emissions are assumed to be the only variable input factor.⁹ To keep things simple we assume a linear production function $y = aE$, with parameter a denoting the input coefficient. As a consequence, the objective function for the industry lobby to be maximised is given by

$$(8) \quad \max Z = aE(L, L^*) - L$$

yielding the first order condition

$$(9) \quad aE_L = 1$$

The subscripts indicate the partial derivative. In this case E_L stands for the partial derivative of E with respect to L . Hence, optimal lobbying is determined by the equality of marginal profit and marginal cost of lobbying¹⁰. The second-order condition is satisfied since $-aE_{LL} < 0$.

⁹ This specification implies a short run view, because we consider the other input factors (capital, labour and technology) as given. Thereby the substitutability of input factors is excluded.

¹⁰ Because lobbying activities L are expressed in expenditure units, the marginal cost of lobbying equals 1.

Assuming Cournot-Nash-Behavior we can derive the slope of the reaction function for the industry lobby:

$$(10) \quad R' = \frac{dL}{dL^*} = -\frac{E_{LL^*}}{E_{LL}}$$

The slope is determined by the sign of the cross derivative. According to equation (7), the reaction function is positively sloped, if $L^* > xL$. It is negatively sloped for $L^* < xL$. If the slope is larger than one in absolute terms, the industry's lobbying expenditures are reduced by more than one unit if green lobbying expenditures are increased by one unit. This implies that total lobbying expenditures will fall. In the case of $L^* = xL$ the slope will be zero.

By analogy, the optimal amount of lobbying by the green interest group is determined by maximisation of the respective objective function

$$(11) \quad \max Z = -a^*E(L, L^*) - L^*$$

with a^*E^* indicating the disutility expressed in monetary terms, which stems from environmental degradation caused by emissions¹¹. This linear relationship implies that the greens consider the marginal environmental damage to be constant.

The first-order condition for the optimal level of green lobbying is

$$(12) \quad -a^*E_{L^*} = 1$$

Hence, the marginal utility of lobbying equals the marginal cost of lobbying. The second order condition is satisfied since $-a^*E_{L^*L^*} < 0$.

Consequently, the slope of the green lobby's reaction function R^* can be calculated as

$$(13) \quad R^* = \frac{dL^*}{dL} = -\frac{E_{LL^*}}{E_{L^*L^*}}$$

¹¹ The parameter a^* can be interpreted as the dollar value change in the green interest groups' perceived disutility as a consequence of a change of the emission level by one unit. For this reason the green lobby maximises the difference of expected environmental damage ($-a^*E$), and the lobbying costs of actively influencing the political decision making process.

Again, the sign of the slope is ambiguous¹². According to equation (7), the slope will be positive if $L^* < xL$ and vice versa. In the case, where both green lobbying and industry lobbying yield the same amount of political pressure i.e. buy the same number of votes ($L^* = xL$), the slope of the curve will be infinite in a LL^* -diagram (which is given by dL/dL^*). Furthermore, if $R^{*'} < -1$, indicating a slope greater than one in absolute terms, an increase of industry lobbying by one unit reduces green lobbying by more than one unit. Consequently total lobbying expenditures will be reduced.

One aim of our analysis is to find out how the lobbying activities of the respective interest groups affect the total emission level. Calculating the total derivatives of E with respect to L and L^* and rearranging the terms yields

$$(14) \quad \begin{aligned} \frac{dE}{dL} &= E_L + R^{*'} E_{L^*} \\ \frac{dE}{dL^*} &= E_{L^*} + R' E_L \end{aligned}$$

Thus, according to the specifications of the respective slopes $R^{*'}$ and R' in this general case the paradox result might occur, that the emission level is influenced in a way not intended by the respective lobbying activities: If $d^2E/dLdL^* < 0$ and consequently $R^{*'} > 0$, the total effect of industrial lobbying on the emission level can be negative. This is the case, when the indirect effect of a change in the marginal lobbying impact of the industrial lobby due to a change in the green's group effort dominates the direct impact of industrial lobbying as expressed by E_L . An analogous reasoning holds for the total effect of green lobbying on the emission level, which might be increased by green lobbying.

In order to analyse the total effects of lobbying on the emission level by the respective interest groups, we substitute the relevant terms for the slopes of the reaction curves, (10) and (13), into equation (14), taking into account equations (5), (6) and (7) and get

¹² Both reaction functions are not independent of each other with respect to their slopes. As the slope of both curves depend on the sign of the cross-derivative, a positively sloped reaction curve for the industry lobby goes together with a negatively sloped curve for the green lobby and vice versa. Furthermore the slope of the respective reaction function may not be the same over the full range of possible values for L^* and L . The actual shapes of the curves depend crucially on the value of the efficiency parameter x , because its reciprocal divides the LL^* -diagram into the areas representing a different sign of the cross-derivatives. In the case of equal efficiency in buying votes ($x=1$) the benchmark line is given by the 45°-Line. At the point where the curve intersects the $1/x$ line the slope of the curves must be zero and infinite respectively. This is depicted in figure 1.

$$(15) \quad \frac{dE}{dL^*} = -\frac{1}{2(xL + L^*)} < 0$$

$$(16) \quad \frac{dE}{dL} = \frac{x}{2(xL + L^*)} > 0$$

In both cases, the impact of lobbying by the respective interest groups is unambiguous. Increased lobbying by the green interest group results *ceteris paribus* always in a reduced emission level. By contrast, increased lobbying of the industry interest group will lead to a higher emission level. According to the specification of our interest group model in combination with the political decision making process, no counterintuitive results are possible in a way, that interest groups can harm themselves by increasing their lobbying activities, i.e. the direct effect of lobbying (dE/dL , dE/dL^*) always dominates the indirect effect indicated by the cross derivatives.

4. Nash Equilibrium in the two-party-model

From the first-order conditions of the two interest groups, the reaction functions and thereby the Nash equilibrium can be derived, graphically depicted by the intersection of the reaction curves of the two interest groups.

Substituting equation (3) into the first-order condition (9) of the industry lobby yields the respective reaction curve .

$$(17) \quad \begin{aligned} a \left(\frac{xbL^*}{(xL + L^*)^2} \right) &= 1 \\ baxL^* &= (xL + L^*)^2 \\ L &= \sqrt{\frac{abL^*}{x}} - \frac{L^*}{x} \end{aligned}$$

By analogy, the reaction curve of the green lobby can be specified.

$$(18) \quad \begin{aligned} -a^* \left(\frac{-xbL}{(xL + L^*)^2} \right) &= 1 \\ ba^*xL &= (xL + L^*)^2 \\ L^* &= \sqrt{a^*bxL} - xL \end{aligned}$$

In the Nash equilibrium, the terms on the right hand side the second line of equations (17) and (18) are equal. Equating (17) and (18), we get

$$\begin{aligned}
 & baxL^* = ba^*xL \\
 (19) \quad & \frac{L}{L^*} = \frac{a}{a^*} \quad \text{thus} \\
 & L = \frac{a}{a^*}L^* \quad \text{or} \quad L^* = \frac{a^*}{a}L
 \end{aligned}$$

As a consequence, the set of all possible Nash equilibria is located along a line through the origin with a slope being equal to a/a^* . There are two intersection points of the reaction functions, one located in the origin and one on the a/a^* line. Hence, the question arises if a unique Nash equilibrium exists. But since in our model it is never optimal not to lobby at all, the intersection point located in the origin can not constitute an equilibrium¹³. For this reason the intersection point on the a/a^* line is a unique Nash equilibrium. Figure 1 depicts a possible Nash solution, given the two reaction curves in the L, L^* -diagram.

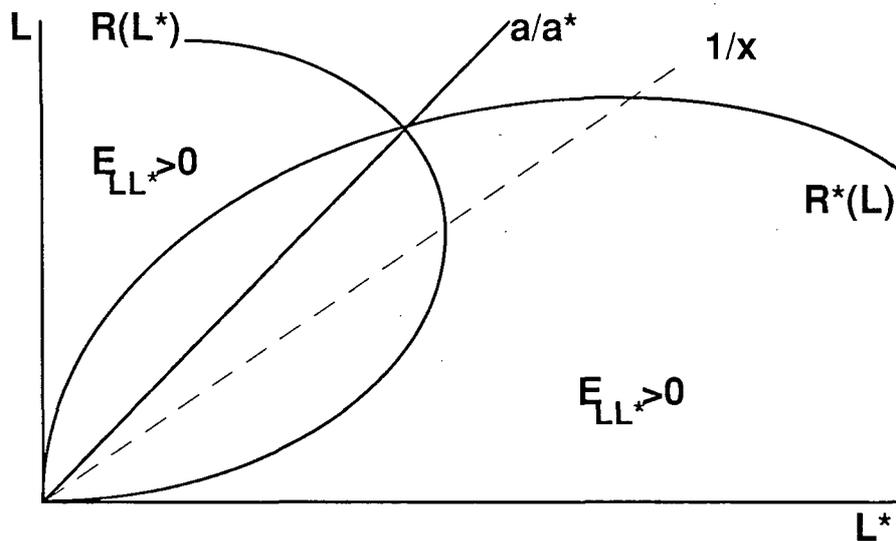


Figure 1

¹³ Note that if one interest group doesn't lobby at all, the other lobby is always better off, if it marginally invests in lobbying according to the definition of the respective objective function.

To determine the level of lobbying in equilibrium by the two interest groups, we substitute the equilibrium condition (19) into the equations of the two reaction curves according to (17) and (18) respectively. The equilibrium lobbying expenditures are given by

$$(20) \quad L = \frac{a^* a^2 bx}{(a^* + ax)^2}$$

for the industry lobby and

$$(21) \quad L^* = \frac{a^{*2} abx}{(a^* + ax)^2}$$

for the green lobby.

If we insert the equilibrium values for L and L^* into the equation of the expected emission level according to equation (2) we get

$$(22) \quad E = E_G + \frac{axb}{ax + a^*}$$

Consequently, the expected emission level in equilibrium depends only on the disutility parameter a^* , the input coefficient a , the parameter indicating the relative efficiency in the electoral competition x and the difference between the announced emission levels by the two parties given by parameter b .

As one would expect, comparative statics yield $dE/da > 0$, $dE/dx > 0$ and $dE/da^* < 0$. Thus in equilibrium, an increased use of emissions in the production process as well as a higher productivity in the political competition by the industry lobby and a lower perceived disutility of emissions by the green lobby induce a higher emission level via the change in lobbying activities according to equations (20) and (21).

Having analysed the levels of lobbying activities and emissions in the Nash equilibrium, we now proceed by looking at the question how total lobbying expenditure is affected by changes in the lobbying behaviour of one group. In order to do this, the slopes of the reaction curves in the Nash equilibrium have to be determined.

They turn out to be

$$(23) \quad R' = \frac{1}{2} \left(\frac{a}{a^*} - \frac{1}{x} \right) < -1 \quad \text{if } (a/a^*) < (1/x) - 2$$

$$> -1 \quad \text{if } (a/a^*) > (1/x) - 2$$

$$(24) \quad R^{*'} = \frac{(a^*/a) - x}{2} < -1 \quad \text{if } (a^*/a) < x - 2$$

$$> -1 \quad \text{if } (a^*/a) > x - 2$$

Both reaction curves are determined solely by the input coefficient a , the disutility parameter a^* and the efficiency factor x . Since (23) and (24) are very similar, the following interpretation will be restricted to the slope of the industry's reaction curve R' . The interpretation of (24) follows by analogy. Given a^*/a , the discouragement effect on industry lobbying by increased lobbying of the green interest group will be stronger for lower values of x i.e. a lower productivity in the industry's lobbying. Thus, for low values of x it is possible, that a small increase in green lobbying will lead to such a reduction of the industry's lobbying activities that the total lobbying expenditure declines, and consequently, the social waste through lobbying is reduced. In the same line of reasoning, the discouragement effect will be strong for high values of a^* , implying a high motivation for green lobbying and low values of a , reducing the incentive for the industrial interest group to engage in lobbying. Thus, parameter changes that increase the lobbying effort of the green group may be beneficial for the economy. Of course, a similar argument applies to the green's reaction curve and it may be possible that an increase in the industry's lobbying yields a reduction in total lobbying.

Although we have seen that the impact of each groups lobbying on the emission level is unambiguous with the consequence that no counterintuitive results are possible, it is nevertheless possible, that lobbying of one interest group discourages or encourages the lobbying activities of the other interest group. As a result, the direct impact of lobbying on environmental pollution may be reinforced or diminished by the lobbying activities of the other interest group. Consequently, the discouragement and encouragement effects determine the outcome of the lobbying competition with respect to the final emission level as well as to the total amount of lobbying expenditures invested in the political decision making process.

5. Lobbying and Its Impact on Government Policy

So far, we have considered situations in which political programmes are given and lobbying activities affect the probabilities of political parties to be elected. This is, however, not the only way in which

interest groups can affect the outcome of the political process. When a party is elected, it does not necessarily stick to the announcement it has made during the election campaign. Thus, the interest groups do not only have to try to have an influence on who rules but also on what kind of decisions are made by the ruling party. In what follows, we assume that this influence is due to a problem of imperfect information. Nobody knows exactly what the social cost of environmental pollution are. In particular, there is a large component of it which is based on subjective evaluations that are not reflected in market prices. The government, however, in order to make a sound environmental policy, needs to have this information. So what it does is to take an estimate of the social cost. This perception of social cost can be influenced by lobbies. For instance, environmentalists generally tend to overstate the risks and costs of environmental disruption whereas industry lobbies often claim that problems of environmental disruption are of minor relevance compared to those of unemployment and international competitiveness. Both these lobbies work hard to convince the ruling politicians that their point of view is the correct one. Their instruments are scientific studies and all kinds of public relations activities in the media.

The politician intends to maximise the social welfare, being the difference between the utility of consumption and the social cost of pollution. Consumption possibilities are affected by environmental policy since output depends on emissions. Let the social welfare function as perceived by the politician be

$$(25) \quad aE - c(E) L^{-z} L^{*y}.$$

aE represents the consumption possibilities and $c(E)$ is a quadratic cost function with positive first and second derivatives. For the sake of a simpler notation, let $c''(E)$ be unity, i.e. $c(E) = \frac{1}{2} E^2$. $c(E)$ measures the true social cost of pollution and y and z are positive parameters measuring the efficiency of lobbying activities. The perception of the social cost is affected by lobbying activities. Each one percent increase in green lobbying raises the perceived social cost by y percent whereas it is reduced by z percent when the industry's lobbying expenditure is increased by one percent. In order to obtain interior solutions, it is necessary to assume that $0 < z < 1$.

Maximisation of (25) with respect to E yields

$$(26) \quad a - c'(E) L^{-z} L^{*y} = 0$$

or

$$(27) \quad E = c'^{-1} [a L^z L^{*y}]$$

The optimal environmental policy has to be determined such that the marginal cost of reducing environmental quality equals the marginal utility of increasing output. The impact of lobbying activities on environmental policy decisions can be determined by differentiating (27) with respect to L and L^* . This yields

$$(28) \quad E_L > 0, E_{L^*} < 0, E_{LL} < 0, E_{L^*L^*} > 0, E_{LL^*} < 0.$$

The first and second derivatives of E with respect to L and L^* have the expected signs. The cross derivative, E_{LL^*} , is unambiguously negative. This implies that an additional unit of green lobbying reduces the marginal productivity of industry lobbying. In contrast, the marginal productivity of green lobbying is enhanced by an increase in industrial lobbying.

Let the objective functions of the greens and the industry be the same as before (eqs. (8) and (11)). The first-order conditions of optimality yield the reaction curves of the two lobbies. The green reaction curve is determined by

$$(29) \quad a a^* y L^z L^{*-y-1} = 1$$

and the polluting industry's reaction curve is

$$(30) \quad a^2 z L^{z-1} L^{*-y} = 1.$$

Nash equilibria are located on a line

$$(31) \quad a^* y L = a z L^*.$$

Total differentiation of (29) and (30) yields the result that the greens' reaction curve is positively sloped whereas the slope of the reaction curve of the polluters' lobby has a negative slope. This is due to the negative sign of the cross derivative of E with respect to L and L^* . Using (31), the slopes of the reaction functions in the Nash equilibrium can be determined. They turn out to be

$$(32) \quad R' = dL/dL^* = za / a^*(z-1)$$

for the polluters' lobby and

$$(33) \quad R^{*' } = dL^*/dL = ya^* / a(1+y)$$

for the green lobby. Of course, the slope of the industrial lobby's reaction curve can be less than (-1) . An increase in green lobbying expenditure by one unit may reduce the emitters' lobbying activities by more than one unit. This implies that parameter change which increase the greens' motivation to

perform lobbying and, therefore, increase green lobbying expenditure reduces the total expenditure on lobbying activities.

The total impact of a change in lobbying activities on emissions has to be determined by taking account of the other lobby's response to this change. Since the polluters are always discouraged by an increase in green lobbying, the emission reduction effect of increased green effort is amplified by the other lobby's reaction. The industry, however, if it increases its lobbying effort, raises the green lobby's motivation to fight for lower emissions. Thus the impact of increased industrial lobbying effort is diminished by the indirect effect which is due to the green lobby's response. The total effect is

$$(34) \quad \frac{dE}{dL} = a z (1+y)^{-1} L^{z-1} L^{*-y}$$

This is obviously positive. Counter-intuitive effects on the level of emissions are, again, not possible. However, if the green lobby's efficiency parameter y is large, the impact of the polluters' lobby can be drastically reduced by green counter-lobbying activities.

6. Summary and Conclusions

The paper has looked at the impact of interest groups that wish to affect the result of the environmental-policy decision making process. Most of the results of this paper are intuitive. In particular, it has been shown that, at least for the model specifications considered in this paper, some of the counter-intuitive results that can be imagined are not feasible. One could have conjectured that an increase in the lobbying activities of one group motivates the counter-lobby so much to increase its effort that the result is the opposite of what has been desired originally. This is not possible here. It is however, possible that increased lobbying by one group discourages the other group so much that total lobbying expenditures are reduced. Increasing one's lobbying activities may be useful from a social welfare point of view because less resources are wasted.

The model may be extended into two directions. First of all, one may wish to consider other specifications of the functional relationships in this model. Perhaps, if more general functions are used, additional scenarios may turn out to be possible. In particular, the counter-intuitive result with respect to the impact of lobbying on environmental policy may become feasible. The other extension is to endogenise the behaviour of the policy maker. Policy makers should be modelled as rational utility maximisers. This means that programmes of political parties will not be taken as given any more and

that the ruling political party follows some self-interest rather than maximise perceived social welfare. We think that extensions into this direction are extremely desirable for a deeper understanding of the political economy of environmental policy.

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