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Collective vs. Individual Lobbying

Norimichi Matsueda
(School of Economics, Kwansei Gakuin University)

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SCHOOL OF ECONOMICS

KWANSEI GAKUIN UNIVERSITY

1-155 Uegahara Ichiban-cho
Nishinomiya 662-8501, Japan

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Norimichi Matsueda*

Abstract

In this paper, we compare the political equilibrium outcomes under two distinct institutional setups concerning the regulated firms' lobbying environment: collective and individual lobbying. Under both regimes, each firm voluntarily chooses whether or not to participate in lobbying activities to influence an environmental regulation with which all the firms need to comply eventually. While, under collective lobbying, firms form a single group before conducting lobbying activities, there is no such pre-coordination under individual lobbying and firms can lobby independently if they wish. The difference in the equilibrium outcomes is quite striking: whereas only a small fraction of firms join the industrial lobbying group under collective lobbying, all the firms participate in lobbying activities in the case of individual lobbying. We also evaluate the desirability of the two lobbying regimes from the perspectives of both individual firms and the society as a whole, and discuss the implications for possible institutional interventions.

Keywords: common agency, compensating equilibrium, environmental regulation, free-rider, lobbying

JEL Codes: D72, H41, Q58

*School of Economics, Kwansei Gakuin University, 1-1-155 Uegahara, Nishinomiya, 662-8501, Hyogo, Japan; nmatsued@kwansei.ac.jp

1 Introduction

Lobbying is considered to be an increasingly important part of a policy-making process in modern democracies. Based on a number of empirical reports, Grossman and Helpman (2001) conclude that "the number of SIGs (Special Interest Groups) active in national politics in the United States is by no means small, and probably continues to grow (page 2)." As for the EU, Dinan and Wesselius (2010) claim that there are about 30,000 lobbyists in Brussels, the same number as the number of EU Commission employees, and it is estimated that lobbyists influence as much as 75% of legislation (The Guardian, 2014).

In particular, industrial interests are quite active in lobbying against stringent environmental regulations. Delmas, Lim and Nairn-Birch (2016) estimate that, in the U.S., major fossil-fuel producers (e.g., ExxonMobil and Chevron), industrial goods manufactures (e.g., General Electric) and some utility firms (e.g., PG&E), each spent $20-30 million dollars lobbying against climate change legislation around 2008-2009. It is also common to observe that industrial interests are represented by consortiums of firms, including trade associations (e.g., American Iron and Steel Institute) and peak business associations (e.g., National Association of Manufactures). For instance, in 2008 the U.S. Chamber of Commerce spent more than $60 million on climate change lobbying (Delmas et al., 2016).

In most of the recent political economics literature, SIGs' political influence through lobby contributions is modeled as a "menu-auction," following the seminal works of Bernheim and Whinston (1986) and Grossman and Helpman (1994). A menu-auction model of lobbying activities is based on the idea that lobby contributions buy influence in policy-making processes.[1] Since its adoptions by Fredriksson (1997) and Aidt (1998) to the analysis of an environmental policy-making, this "common agency" approach has steadily gained in popularity in the field of environmental economics as well. For instance, it has been used to analyze the interaction between international trade and environmental

[1]There are an abundance of empirical findings to support this claim. For instance, Baldwin and Magee (2000) looked at how legislators voted on several trade bills and found that the probability of a vote in favor of trade liberalization increased with the amount of contributions that a legislator received from business interests and fell with the amount collected from labor unions.

policies (Eliste and Fredricksson, 2002; and Lai, 2007), and the influences of domestic lobbying activities on international environmental agreements (Habra and Whinkler, 2012; and Marchiori, Dietz and Tavoni, 2017).

In most of the models which utilize the common agency framework, the organizational aspects of respective lobbyists are taken for granted, and not much attention has been paid to how lobby groups are originally formed. However, it is quite probable that different institutional settings induce strikingly different forms of lobby organizations, which in turn lead to varied efficiency implications and distributional impacts. In his early survey of the literature, Persson (1998) considers exogenous supposition of lobby groups a crucial and difficult question to which there is no satisfactory answer despite the important aspects of the problem raised by Olson (1965). In his more recent survey of the literature, van Winden (2008) considers it one of strong assumptions of existing common agency models to suppose that "interest groups are exogenously given, of fixed size and are assumed to behave as unitary actors."

Since Persson (1998), indeed, there have been several papers that address the issue of endogenous formation of lobby groups, based on the common agency model. The main strand of works on endogenous lobby formation approaches the problem by focusing on the role of a fixed cost which must be incurred in participating in lobbying activities (Mitra, 1999; Damania and Fredricksson, 2003; and Laussel, 2006).[2] These studies reveal how the characteristics of the fixed cost is related to the lobby formations and resulting political equilibrium outcomes. They also clarify the conditions to ensure the uniqueness of an equilibrium for a lobby formation game.

Unlike other works, Damania and Fredricksson (2000), not including a fixed cost in their formulation, set up an infinitely-repeated duopoly model and investigate into the relation between the collusive profits of the industry and the degree of political activities.[3] In their formulation, they suppose that the formation of a lobby group is equivalent to

[2] The idea of the fixed "organizing" cost originally appears in Stigler (1971) and Peltzman (1976). Felli and Merlo (2006) also consider the endogenous determination of lobby groups, but their study is quite different from ours as well as the other works cited here, in that their framework is a citizen-candidate model of Osborne and Slivinski (1996) and Besley and Coate (1997), and also in that it is the politician who selects the lobby groups he/she would bargain with, and not the lobbyists themselves.

[3] We show below that, in out setup, the collusiveness of an industry is not important in inducing firms to join the lobbying activities.

each firm independently offering the government a political contribution schedule. This situation is considered in this paper to be the case of "individual lobbying." Under individual lobbying, each decision-maker can decides whether or not it conducts lobbying activities, concurrently with how it would lobby if it enters the lobbying game.[4]

As is described above, consortiums of business entities usually have outstanding lobbying presence in environmental issues as in other areas of economic and societal policy-makings. Therefore, we also analyze a different case where firms coordinate their lobbying activities before they actually lobby. We refer to this situation as "collective lobbying." Under the collective lobbying regime, those who share the same or similar interest first organize a single lobby group before they actually conduct lobbying activities as a single lobbyist. In a sense, this situation can be interpreted as a case where a certain explicit or implicit institutional restriction is imposed on the lobby formation, such as a minimum size requirement for being qualified as a lobbyist. Such a restriction on potential lobbyists might be socially desirable when there are significant transaction costs involved in each lobbying process.[5] We explore the impacts of this type of institutional intervention on social welfare as well as on the other aspects of the equilibrium outcome, such as the degree of lobby participation and resulting payoff for each firm.

In this paper, we use a highly-aggregated model of an environmental policy-making under lobbying activities. In endogenizing the process of lobby participation, we do not consider the role of a fixed cost of organizing a lobby group, and, as a new contribution to the existing literature, we compare the two distinct institutional environments concerning the lobby formation; collective and individual lobbying. Our main research questions are as follows. If there are multiple entities which share the same or similar interests, how lobbying activities will be conducted, especially, under different institutional environments concerning lobby formation? Are they better off lobbying together or independently? What are the implications of having different institutional setups for social welfare?

[4]While our framework is essentially a one-shot game, we offer a dynamic interpretation of this regime when the game is repeated in 3.2 below.

[5]In addition, such a restriction can be also beneficial to the affected lobbyists if they can take advantage of certain scale economies in organizing an interest group and conducting lobbying activities through sharing a variety of resources, although we do not include this potential benefit in our model below.

The difference in the lobbying regimes produces strikingly different equilibrium properties. While only a small fraction of firms are engaged in lobbying activities under the collective lobbying regime, all the firms participate in lobbying in the unique equilibrium under individual lobbying. As for the collective lobbying regime, we find that the equilibrium outcome is unanimously less preferred by all the firms to the outcome where all of them are collectively engaged in lobbying. This result is akin to the classic observation made by Olson (1965), who discusses the free-rider issue in a broad context and argues that, when interests are shared, rational actors should prefer to free-ride and let others pay the cost of goods that will benefit everyone.

Under the individual lobbying regime, on the other hand, every firm voluntarily chooses to lobby for a policy which benefits not just itself but those who share the common interest in having a laxer environmental regulation. Rather paradoxically, hence, seemingly "coordinated" mutually-beneficial actions by lobbyists take place only when the group formation process is not pre-coordinated. In a sense, if lobby formation is more loosely organized, the industry can achieve a better result for each one of its members. From the social welfare perspective, however, the restriction that an individual firm has no political access to the policymaker can be desirable although it would be harmful to each individual firm. In such a case, however, certain types of social interests might be significantly underrepresented according to our result.[6] This possibility should be taken into account in designing a socially preferable intervention on lobby formation.

In section 2, we set up a simple model of an environmental policy-making under lobbying activities, focusing on the two distinct institutional environments for lobby formation. In the ensuing section, we derive and compare the political equilibrium outcomes under the different cases, and discuss the implications for possible institutional designs. The final section concludes the paper.

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[6]An potential counteracting force is the presence of certain scale economies in forming a single lobby among multiple entities by sharing indispensable resources in lobbying.

2 The Model

Following a typical formulation of a lobbying game model in the literature, we consider an economy with a national government which is assumed to be represented by a single policymaker. The policymaker is usually considered as a ruling party of the nation and has an interest in receiving political contributions from lobbyists.[7] Such contributions can benefit the policymaker in several ways, including helping him/her to be reelected in the next election. At the same time, the policymaker is concerned with the social welfare of the general public partly because it would also affect the prospect of his or her re-election.[8] For simplicity, we suppose that the policymaker makes his or her decisions on the environmental regulation at hand, independently of the other political agendas.

As for the other parties, there exist producers and consumers of goods which emit a particular pollutant in their production and/or consumption, and they respectively derive the benefits from the pollutant emissions, denoted by e, during their production and consumption processes in terms of cost savings, for example. We assume that there exist a sufficiently large number, N, of symmetric entities which respectively benefit from the pollutant emission. Specifically, we suppose $N \geq 4$ in the analysis of the next section. For the sake of convenience, we call each entity a "firm" throughout the paper, even if it can potentially include consumers that profit from a laxer emission control through cheaper product prices.

We write the benefit of the pollutant emission as $B(e)$ for a single firm. On the environmental damage side, we denote the damage cost to the whole society due to the pollutant emissions from a single firm as $D(e)$. Thus, the social welfare of the citizens

[7]Grossman and Helpman (2001) report that 78 percent of the monies from the PACs (Political Action Committees) went to incumbent candidates in 1997-1998.

[8]Note that we are excluding neither altruism nor statesmanship on the part of a policymaker.

affected by this environmental regulation, $W(e)$, is given by[9]

$$W(e) = N(B(e) - D(e)). \tag{1}$$

Here, we choose the unit of measuring the level of e so that the benefit is effectively represented by a linear function in e as follows:[10]

$$B(e) = \beta \cdot e, \tag{2}$$

where β is a positive parameter. On the other hand, the damage cost due to the emissions by one firm is represented by a strictly increasing and convex function. For simplicity, we assume the damage cost to be represented by a quadratic function in e:

$$D(e) = \frac{1}{2} \cdot \delta \cdot e^2, \tag{3}$$

where δ is a positive parameter.

Let us first consider the case where the policymaker maximizes its domestic social welfare defined in (1) by choosing the emission limit, e, for each firm. Such a welfare-maximizing emission limit, e^*, can be easily obtained as

$$e^* = \frac{\beta}{\delta}. \tag{4}$$

In reality, a policymaker is likely to have other interests than simply maximizing social welfare in choosing the per-firm emission limit. Following the literature, we consider that the payoff of the policymaker is given by the weighted sum of the social welfare of its own citizens, given by $W(e)$, and the amount of contributions provided by the

[9]Here, we effectively suppose that, when an emission limit is imposed by the policymaker, each firm always emits up to this exact level in order to maximize its benefit. Also, we assume that the policymaker cannot implement different levels of emission control across firms. In reality, relatively cleaner firms might lobby for a stricter environmental regulation if that bestows those firms with competitive advantages over other firms (Delmas et al., 2016). For the sake of simplicity, however, we consider that all the firms are uniform and, moreover, that a stricter emission control always results in financial losses for the firms.

[10]Alternatively, we can suppose that the polluting industry is contained in a small open economy and also that an extra unit of emissions allowed yields each price-taking firm some constant amount of benefits. However, applications of the current model are much broader than what this alternative formulation suggests.

lobbyists. We suppose that the parameter, $\theta \in [0, \frac{1}{2}]$, is the weight attached to the social welfare, net of the contributions by the lobbies, and $(1-\theta)$ is the weight attached to the contribution amounts in the mind of the policymaker.[11] Our setup indicates that a decrease in θ represents an increase in the openness of the policymaker to lobby contributions in comparison with social welfare.

Lobbying activities in a common agency model are succinctly summarized by the simultaneous offerings of "contribution schedules" by lobbyists, which express how much respective lobbyists commit themselves to pay to a policymaker when a certain level of the emission limit is chosen subsequently by the policymaker. Let us suppose that the policymaker obtains the total contribution amount of c from the lobbyists. Noting that the contributions by lobbyists imply a decrease in the net welfare of the citizens by the same amount, the policymaker's payoff can be written as

$$\theta \{W(e) - c\} + (1-\theta)\, c = \theta W(e) + (1 - 2\theta)\, c. \tag{5}$$

Now, we introduce lobbyists to the model. For the sake of simplicity, we assume that there exist only one environmental lobby (indexed by G), which is concerned only with the magnitude of environmental damages inflicted upon its members.[12] Provided that the environmental lobbyist promises to pay the amount of $C_G(e)$ as its lobby contribution when e is chosen by the policymaker, its net payoff becomes[13]

$$U_G(e, C_G(e)) = -\omega_G N \cdot D(e) - C_G(e), \tag{6}$$

where $\omega_G \in [0, 1]$ is called the organization ratio of the environmental lobby and indicates how much of the cost from the total pollutant emissions is represented by this lobbyist. In order to focus on how the industry lobby is formed under different regimes, we suppose that ω_G is exogenously given in this study.

[11] We suppose that the maximum possible value of the parameter θ is $\frac{1}{2}$, because, if θ exceeded $\frac{1}{2}$, the policymaker would value the welfare of the citizens higher than the lobby contributions, and so never accept any contributions from lobby groups.

[12] In fact, the setup is easily extended to a case of multiple independent environmental lobbies as in the case of individual lobbying by the industrial lobbyists described below.

[13] For simplicity, all the lobby contributions are measured in a monetary term throughout this paper.

The following two subsections describe the two possible environments under which the industrial lobbying activities are conducted, and also explain how an equilibrium outcome can be obtained in each case.

2.1 Collective Lobbying

As for the case of collective lobbying, we suppose that, in order to join a lobby group, each firm first commit itself to be a part of the industrial lobby group and, after having formed one industrial lobby group, the lobbyist actually works as a single entity. The industrial lobbyist, which consists of $M(\leq N)$ firms, conducts lobbying activities so as to maximize its collective payoff. More specifically, we model this case as a sequential game where each individual firm voluntarily decides whether or not to join the industrial lobby in the first stage, and, having formed one group which exclusively represents the industrial interest of its own, the lobbyist collectively engages in lobbying activities in the second stage, concurrently with the environmental lobbyist described above. Again, lobbying activities here are summarized as a proposal of a contribution schedule, which depends solely on the subsequent choice by the policymaker.

Taking into account the potential lobby contributions, $C_M^C(e)$, which it commits itself to pay when e is chosen by the policymaker,[14] the collective payoff of the industrial lobby is given by

$$U_M^C(e, C_M^C(e)) = \omega_P(M)N \cdot B(e) - C_M^C(e), \tag{7}$$

where $\omega_P(M) = \frac{M}{N} \in [0, 1]$ denotes the organization ratio of the industrial lobby when $M(\leq N)$ firms have decided to join the lobby in the first stage.

We denote the resulting equilibrium emission limit when M firms participate in the collective lobbying by e_M^C. As an important assumption, we suppose that participating firms in this lobby split the total contribution amount equally among them and, thereby, ignore the potential effects of some scale economies and transaction costs associated with lobbying. Then, the payoff of a firm in the industrial lobby group is

$$B(e_M^C) - \frac{1}{M} C_M^C(e_M^C). \tag{8}$$

[14] The superscript C denotes the case under collective lobbying.

Since a firm would obtain $B(e^C_{M-1})$ by choosing not to participate in lobbying, the equilibrium number of the firms which join the industrial lobby group in the first stage is given by the largest non-negative integer M which satisfies

$$B_M(e^C_M) - \frac{1}{M} C^C_M(e^C_M) \geq B(e^C_{M-1}). \tag{9}$$

Or,

$$B(e^C_M) - B(e^C_{M-1}) \geq \frac{1}{M} C^C_M(e^C_M). \tag{10}$$

In the above inequality, the left-hand side is the benefit of a firm joining the lobby group, which is given by the increase in its benefit due to stronger lobbying efforts made collectively by the industrial lobbyist, and the right-hand side is the cost of joining the lobby group in terms of having to pay its share of the lobby contribution.

2.2 Individual Lobbying

If individual firms are lobbying independently or separately, there is no lobby formation stage as in the case of collective lobbying, and each firm directly engages in lobbying activities if it chooses to do so. Taking into account the potential lobby contributions, $C^I_M(e)$, i.e., how much its promise to pay according to the level of e under individual lobbying when the total of M firms are lobbying,[15] the payoff of one particular lobbying firm under individual lobbying, $U^I_M(e)$, is given by

$$U^I_M(e, C_i(e)) = B(e) - C^I_M(e). \tag{11}$$

A single firm's payoff from participating in its own lobbying activities when $M-1$ other firms are also lobbying individually is given by

$$B(e^I_M) - C^I_M(e^I_M), \tag{12}$$

where e^I_M denotes the equilibrium level of e under individual lobbying when M firms are lobbying in total.

[15]The superscript I denotes the case under individual lobbying.

If a firm does not lobby itself, its payoff becomes $B(e^I_{M-1})$. Therefore, the firm should lobby if and only if

$$B(e^I_M) - C^I_M(e^I_M) \geq B(e^I_{M-1}). \tag{13}$$

Therefore, the equilibrium number of the firms which take part in lobbying is given by the largest non-negative integer M which satisfies

$$B(e^I_M) - B(e^I_{M-1}) \geq C^I_M(e^I_M). \tag{14}$$

3 Analysis

As for a lobbying game which involves the policymaker and the lobbyists, we focus on a so-called "compensating equilibrium." This equilibrium concept provides a sharp prediction on the outcome of the game, especially concerning the contribution amounts.[16] A compensating equilibrium is based on the idea that, if there were a change in the policy, the change in contribution should compensate a lobbyist for that change in the policy, so that the lobbyist's payoff remains the same. Such an amount of contribution can be expressed as a "compensating contribution schedule," and an equilibrium that arises when all groups use compensating contribution schedules is called a compensating equilibrium.

Grossman and Helpman (2001) show that, no matter what type of contribution schedules a given group's rivals are expected to follow, the group can always respond with a compensating contribution schedule at no extra cost. Further rationales are offered by Grossman and Helpman (2001) for concentrating on a compensating equilibrium, such as its characteristics of being uniquely both Pareto-efficient and coalition-proof, which could potentially make the equilibrium a focal point of a lobbying game. The derivation of the compensating equilibrium is detailed in Grossman and Helpman (1994) and Grossman and Helpman (2001), and we adapt their procedure to our environmental regulation model.

[16]Otherwise, multiple equilibrium is a norm in a menu-auction model. A compensating equilibrium concept was originally called a truthful equilibrium (Bernheim and Whinston 1986, and Grossman and Helpman 1994) although a lobby interaction is usually modeled as a game of complete information. The term "compensating" seems more appropriate as it nicely reflects the relationship between the contribution level and the economic concept of Hicksian compensating variation (Grossman and Helpman, 2001).

3.1 Collective Lobbying

Let us suppose that the total of $M(\leq N$, where $N \leq 4$ by assumption) firms have constituted the industrial lobby group in the initial lobby formation stage. Thus, the industrial lobby's joint payoff is given by (7). On the other hand, the environmental lobby's payoff is given by (6).

As has been described above, these two lobbyists and the policymaker play a sequential game within the subsequent lobbying game stage. To start off, the two lobbies respectively present their own contribution schedules to the policymaker. Such schedules are given by $C_M^C(e)$ for the industrial lobby and $C_G^C(e)$ for the environmental lobby in the collective lobbying case.[17] These contribution schedules are based only on the emission limit chosen by the policymaker, and their provisions are fully committed by the lobbies. Then, the policymaker chooses the emission limit per firm, e, so as to maximize its own payoff.

When both lobbyists are contributing, the policymaker's payoff with lobbying contributions, denoted by $Z(e)$, is written as

$$Z(e) = \theta \left(N \cdot B(e) - N \cdot D(e) - C_M^C(e) - C_G^C(e)\right) + (1-\theta) \left(C_M^C(e) + C_G^C(e)\right), \quad (15)$$

where $\theta \in [0, \frac{1}{2}]$ is the weight attached to the social welfare, net of the contributions by the lobbyists, and $(1-\theta) \in [\frac{1}{2}, 1]$ is the weight attached to the contribution amounts.

At the political equilibrium under collective lobbying, whose emission limit is denoted by e_M^C, the equilibrium outcome must be jointly efficient for the government and the two lobbyists.[18] In order to derive such an emission limit, let us fix the payoffs of the lobbyists at certain pre-determined levels. In particular, the two lobby groups respectively achieve the payoffs of $U_M^C(e_M^C, C_M^C(e_M^C))$ and $U_G(e_G^C, C_G^C(e_M^C))$ at the political equilibrium. Thus, we use the following equality as the constraint in the problem to find the jointly efficient emission level:

$$C_M^C(e) + C_G^C(e) = \omega_P(M) \cdot N \cdot B(e) - U_M^C(e_M^C, C_M^C(e_M^C)) - \omega_i^G N \cdot D(e) - U_G(e_M^C, C_G^C(e_M^C)). \quad (16)$$

[17] Thus, we replace $C_G(e)$ by $C_G^C(e)$ in (6) to have $U_G(e, C_G^C(e)) = -\omega_G N \cdot D(e) - C_G^C(e)$ for the payoff of the environmental lobby under collective lobbying.

[18] The proof can be found in pages 268-269 of Grossman and Helpman (2001).

Inserting (16) into (15), the policymaker's payoff under this constraint becomes

$$
\begin{aligned}
Z(e) = &\{\theta + (1-2\theta)\,\omega_P(M)\}\, N \cdot B(e) - \{\theta + (1-2\theta)\,\omega_G\}\, N \cdot D(e) \\
&+ (1-2\theta)\left(U_M(e_M^C, C_M^C(e_M^C)) + U_G(e_M^C, C_G^C(e_M^C))\right).
\end{aligned} \tag{17}
$$

The first-order condition for maximizing (17) with respect to e under (2) and (3) is

$$\{\theta + (1-2\theta)\,\omega_P(M)\}\,\beta - \{\theta + (1-2\theta)\,\omega_G\}\,\delta e = 0. \tag{18}$$

Solving (18) for e, we obtain the following jointly-efficient level of emissions, e_M^C, which arises in the political equilibrium of this common agency game under the collective lobbying activities by M firms:

$$e_M^C = \frac{\theta + (1-2\theta)\,\omega_P(M)}{\theta + (1-2\theta)\,\omega_G} \cdot \frac{\beta}{\delta}. \tag{19}$$

Now, we turn to a more demanding task of identifying the contribution amounts, i.e., $C_M^C(e_M^C)$ and $C_G^C(e_M^C)$, at this political equilibrium under collective lobbying. Here, the idea of a compensating equilibrium plays a crucial role in circumventing the issue of multiple equilibria.

Taking into account the lobby contribution, the payoff of the environmental lobby at this equilibrium under collective lobbying can be written as

$$U_G(e_M^C, C_G^C(e_M^C)) = -\omega_G N \cdot D(e_M^C) - C_G^C(e_M^C). \tag{20}$$

Following Grossman and Helpman (2001), we define the compensating contribution schedule to be the one that coincides with a lobbyist's indifference curve through the political equilibrium whenever the contribution amount is positive. The contribution amount is simply zero elsewhere in the compensating schedule. In particular, the compensating contribution schedule of the environmental lobby under collective lobbying, denoted by $H_G^C(e)$, is

$$H_G^C(e) = \max\left\{-\omega_i^G N \cdot D(e) - U_G(e_M^C, C_G^C(e_M^C)), 0\right\}. \tag{21}$$

Given the above information, we can find the level of the emission limit that the policymaker would choose in the absence of contribution from the industrial lobby, e_{-P}.

In this case, the policymaker would maximize a weighted sum of the net social welfare and the contribution from the environmental lobby alone.[19] This maximization problem leads to

$$e_{-P} = \frac{\theta}{\theta + (1 - 2\theta)\,\omega_G} \cdot \frac{\beta}{\delta}. \tag{22}$$

The relationship between the political equilibrium and e_{-P} is graphically illustrated in Figure 1.

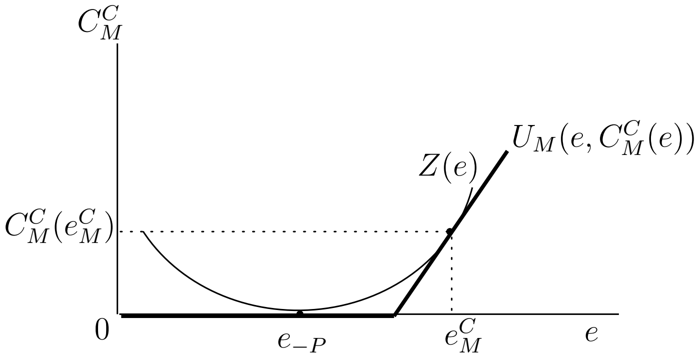

Figure 1: The political equilibrium and the emission limit without the industrial lobby

In Figure 1, we have the level of emission on the horizontal axis and the contribution by the industrial lobby under collective lobbying on the vertical axis. The indifference curve for the policymaker, which now incorporates the compensating contribution schedule of the environmental lobby, and the indifference curve for the industrial lobby, which consists of M firms, through the political equilibrium, e_M^C, are shown as the curves indexed by $Z(e_M^C)$ and $U_M(e_M^C, C_M^C(e_M^C))$, respectively. The compensating contribution schedule of the industrial lobby, $H_M^C(e)$, is depicted by the bold line. In particular, the contribution level of the industrial lobby at the political equilibrium is given by $C_M^C(e_M^C)$.

At such an equilibrium, the industrial lobby must provide a sufficient contribution to ensure that the policymaker chooses e_M^C, instead of e_{-P}, which is the potentially chosen emission limit with no contribution from the industrial lobbyist. By denoting the payoff of the policymaker in the absence of the industrial lobby by $Z_{-P}(e)$, therefore,

[19]In deriving e_{-P}, the weight attached to the net social welfare is still θ while the weight attached to the contribution from the environmental lobby is $1 - \theta$, just as in the case of multiple lobbyists above. In fact, though, e_{-P} can be obtained simply by setting $\omega_P(M) = 0$ in (19).

$Z_{-P}(e_{-P}) = Z(e_M^C)$ must hold. In other words, at the political equilibrium, we have

$$\begin{aligned}&\theta N\left(B(e_{-P}) - D(e_{-P})\right) + (1-2\theta)\left(-\omega_G N \cdot D(e_{-P}) - U_G(e_M^C, C_G^C(e_M^C))\right)\\ &\quad = \theta N\left(B(e_M^C) - D(e_M^C)\right) + (1-2\theta)\left(C_M^C(e_M^C) + C_G^C(e_M^C)\right),\end{aligned} \tag{23}$$

which leads to[20]

$$\begin{aligned}(1-2\theta)\, C_M^C(e_M^C) &= \theta N\left\{B(e_{-P}) - D(e_{-P}) - \left(B(e_M^C) - D(e_M^C)\right)\right\}\\ &\quad + (1-2\theta)\,\omega_G N\left(D(e_M^C) - D(e_{-P})\right),\end{aligned} \tag{24}$$

Using the specific benefit and damage cost functions, i.e., (2) and (3), (24) can be written as[21]

$$\begin{aligned}&(1-2\theta)\, C_M^C(e_M^C) =\\ &N\left(e_M^C - e_{-P}\right)\left[\left\{\theta + (1-2\theta)\,\omega_G\right\} \cdot \tfrac{\delta}{2} \cdot \left(e_M^C + e_{-P}\right) - \theta\beta\right],\end{aligned} \tag{25}$$

where e_{-P} is given by (22). From (25), we can obtain

$$C_M^C(e_M^C) = \frac{N}{2} \cdot \frac{(1-2\theta)\left(\omega_P(M)\right)^2}{\theta + (1-2\theta)\,\omega_G} \cdot \frac{\beta^2}{\delta}. \tag{26}$$

Given (19), (26) and $\omega_P(M) = \frac{M}{N}$, the inequality (10) holds if and only if the following inequality holds.

$$\frac{1-2\theta}{N\left\{\theta + (1-2\theta)\,\omega_G\right\}} \cdot \frac{\beta^2}{\delta} \geq \frac{M}{2N} \cdot \frac{1-2\theta}{\theta + (1-2\theta)\,\omega_G} \cdot \frac{\beta^2}{\delta}, \tag{27}$$

which reduces to $M \leq 2$. This means that, in the initial lobby formation stage, the subgame-perfect equilibrium number of the firms which join the industrial lobby is either one or two.[22] Thus, we can conclude that, under collective lobbying, only two firms, at most, participate in the industrial lobby, no matter what are the values of economic and political parameters.

As we can see in (27), its left-hand side, which is one particular firm's benefit of joining the industrial lobby, is constant with respect to M, while the right-hand side, which is the cost of participating in collective lobbying activities, is indeed an increasing function

[20] Here, we make use of the compensating schedule of the environmental lobby, i.e., $C_G^C(e) = -\omega_G N \cdot D(e) - U_G\left(e_M^C, C_G^C(e_M^C)\right)$ whenever $C_G^C(e) > 0$ according to (21).

[21] We can confirm that the value of $C_M^G(e_M^C)$ is strictly positive.

[22] Since $\frac{\partial\left(\frac{1}{M} C_M^C(e_M^C)\right)}{\partial M} > 0$, there is no other equilibrium outcome.

of M because the collective contribution given by (26) is quadratic in M. The two sides in (27) are exactly equal to each other at $M = 2$, and the latter exceeds the former for all $M > 2$. This result implies that, since we have assumed that the regulated industry contains at least four firms, i.e., $N \geq 4$, the full organization of the industrial lobby is impossible under collective lobbying.

We should note that, while this maximum number of 2 for the firms in the industry lobbyist is due partly to the specific functional forms used in this model, the qualitative implications of this result is not restricted to its specificity, and can be explained by using the graphs of the functions depicted in Figure 1. An addition of a firm to the industrial lobby leads to an increase in the slope of the indifference curve of the industrial lobbyist, i.e., $U_M(e, C_M^C(e))$. Then, an increase in its slope relative to $Z(e)$ at any particular emission level raises the equilibrium contribution by the industry lobby while it also increases the emission limit at the political equilibrium. Because of the curvatures of the two functions, the cost of the former for the participating firms will eventually outweigh the benefit of the latter as more firms join the industrial lobby, thereby preventing the realization of full participation by the firms in lobbying.

Let us interpret this result intuitively. In deciding on whether or not to join the industrial lobby, a firm realizes that, once it has joined the industrial lobby, the lobby collectively pursues the joint-benefit maximization among the participants. Thus, each firm in the lobby is forced to take into account the benefit accrued to the other firms within the lobby group and, as the number of firms in the group increases, this quickly becomes too significant a burden for a firm to be compensated by the benefit it gains through a relaxed emission control. In other words, when only the other two firms are participating in lobbying activities, the excess burden a firm shoulders in contributing for lobbying activities is too overbearing, compared to the benefit it receives through its own added lobbying efforts. Thus, any attempt to pre-coordinate the lobbying activities among firms will face a free-rider problem, although not completely, as is argued by Olson (1965).[23]

[23] Contrary to Olson (1965), who states that a group size is inversely related to successful collective action leading to a sub-optimal level of provision when there are multiple actors due to the free-rider consideration, our result does not yield any negative relationship between a group size and the effectiveness of the group, however.

Does this imply that the collective lobbying case is an example of a Prisoners' Dilemma type situation? Certainly, it is different from a classic Prisoners' Dilemma case in that a limited number of firms voluntarily contribute to lobbying activities, but it has some similarity to a Prisoners' Dilemma situation in the sense that even a free-rider in the subgame perfect outcome could receive a higher payoff if somehow all the firms participated in collective lobbying. This can be easily checked by comparing the payoff of a firm which does not lobby under the collective lobbying, i.e., $B(e_2^C)$ or $B(e_1^C)$, to a hypothetical payoff of a firm if all the firms joined the collective lobbying, i.e., $B(e_N^C) - \frac{1}{N} C_N^C(e_N^C)$. From (19) and (26), we can show that $B(e_N^C) - \frac{1}{N} C_N^C(e_N^C) \geq B(e_2^C) > B(e_1^C)$ if and only if $N \geq 4$. Since a firm which joins the lobbying activities needs to contribute and is definitely worse off than a free-rider, the equilibrium outcome under collective lobbying is indeed Pareto-inferior, as far as only the firms are concerned, to the hypothetical outcome where every firm joins the industrial lobby group.

Whereas these results we have obtained so far under the collective lobbying regime generally conform to the free-rider issue in the organization of a lobby group, as is discussed by Olson (1965) and Damania and Fredriksson (2000), quite different equilibrium results are obtainable under an alternative lobbying environment as we see in the next subsection.

3.2 Individual Lobbying

The joint-efficiency property of a compensating equilibrium still holds even if a certain number of firms are lobbying independently. Thus, when M firms are lobbying individually, the resulting emission limit from the lobbying game, e_M^I, is:

$$e_M^I = e_M^C = \frac{\theta + (1 - 2\theta)\,\omega_P(M)}{\theta + (1 - 2\theta)\,\omega_G} \cdot \frac{\beta}{\delta}. \tag{28}$$

The difference from the collective lobbying case lies solely in the amount which a single lobbying firm contributes to the policymaker. In identifying the exact lobby contribution of each firm, we follow a similar procedure to the one for the collective lobbying case above. If one particular firm refrained from lobbying itself, it would face a different level of the emission limit, e_{M-1}^I, which is lower than e_M^I, according to (28). In order to ensure that the policymaker chooses e^I_M instead of e^I_{M-1}, this firm must provide a sufficient contribution $C^I_M(e^I_M)$. By denoting the policymaker's hypothetical payoff in the absence of the contribution from this particular firm by $Z_{M-1}(e)$, therefore, $Z_{M-1}(e^I_{M-1}) = Z(e^I_M)$ must hold. In other words, at the political equilibrium, we have

$$\begin{aligned} &\theta N \left(B(e^I_{M-1}) - D(e^I_{M-1})\right) \\ &+ (1-2\theta)\left\{(M-1)B(e^I_{M-1}) - \omega_G N \cdot D(e^I_{M-1}) - \textstyle\sum_{j\in M-1} U_j(e^I_M, C^I_M(e^I_M)) - U_G(e^I_M, C^I_G(e^I_M))\right\} \\ &= \theta N \left(B(e^I_M) - D(e^I_M)\right) + (1-2\theta)\left(C^I_M(e^I_M) + \textstyle\sum_{j\in M-1} C^I_j(e^I_M) + C^I_G(e^I_M)\right), \end{aligned} \tag{29}$$

where $C^I_j(\cdot)$ is the contribution from a firm $j \in M-1$ and $C^I_G(\cdot)$ is the contribution from the environmental lobby.[24] Substituting the compensating contribution schedules into (29),[25] we have

$$\begin{aligned} (1-2\theta)\, C^I_M(e^I_M) &= \theta N \left\{B(e^I_{M-1}) - D(e^I_{M-1}) - \left(B(e^I_M) - D(e^I_M)\right)\right\} \\ &+ (1-2\theta)\left\{(M-1)\left(B(e^I_{M-1}) - B(e^I_M)\right)\right\} + \omega_G N \left(D(e^I_M) - D(e^I_{M-1})\right). \end{aligned} \tag{30}$$

Using the specific benefit and damage cost functions, i.e., (2) and (3), (30) can be written as[26]

$$\begin{aligned} &(1-2\theta)\, C^I_M(e^I_M) = \\ &\left(e^I_M - e^I_{M-1}\right)\left[N\left\{\theta + (1-2\theta)\,\omega_G\right\} \cdot \tfrac{\delta}{2} \cdot (e^I_M + e^I_{M-1}) - \left\{\theta N + (1-2\theta)\,(M-1)\right\}\beta\right]. \end{aligned} \tag{31}$$

From (31), we can obtain

$$C^I_M(e^I_M) = \frac{1}{2N} \cdot \frac{1-2\theta}{\theta + (1-2\theta)\,\omega_G} \cdot \frac{\beta^2}{\delta}, \tag{32}$$

which is independent of M, in contrast to (26), and, moreover, the following inequality

[24] Also, the payoff of the environmental lobby under individual lobbying is expressed as $U_G(e, C^I_G(e)) = -\omega_G N \cdot D(e) - C^I_G(e)$ by replacing $C_G(e)$ by $C^I_G(e)$ in (6).

[25] Similarly to the collective case above, the compensating contribution schedules are given by $C^I_j(e) = B(e) - U_j\left(e^I_M, C^I_G(e^I_M)\right)$ for $j \in M-1$ and $C^I_G(e) = -\omega_G N \cdot D(e) - U_G\left(e^I_M, C^I_G(e^I_M)\right)$ whenever $C^I_M(e) > 0$ and $C^I_G(e) > 0$, respectively.

[26] We can confirm that the values of $C^I_j(e^I_M)$ and $C^I_G(e^I_M)$ are both strictly positive.

holds:

$$B(e^I_M) - B(e^I_{M-1}) = \frac{1}{2N} \cdot \frac{1}{\theta + (1-2\theta)\,\omega_G} \cdot \frac{\beta^2}{\delta} \geq C^I_M(e^I_M), \tag{33}$$

since we have $\theta \in [0, \frac{1}{2}]$ by assumption. As the above inequality holds for any value of M, the benefit of lobbying always outweighs the cost of lobbying for an individual firm, regardless of the number of the other firms that are lobbying simultaneously. Accordingly, we can state[27]

Proposition 1. *Under individual lobbying, we have a unique Nash equilibrium where all the firms participate in lobbying.*

This outcome is in stark contrast to the equilibrium result in the collective lobbying case, where only two firms, at most, participate in lobbying. As a consequence, the equilibrium emission limit under individual lobbying becomes $e^I_N = \frac{\theta+(1-2\theta)}{\theta+(1-2\theta)\omega_G} \cdot \frac{\beta}{\delta}$, which is greater than $e^C_1 = \frac{\theta+(1-2\theta)\frac{1}{N}}{\theta+(1-2\theta)\omega_G} \cdot \frac{\beta}{\delta}$ and $e^C_2 = \frac{\theta+(1-2\theta)\frac{2}{N}}{\theta+(1-2\theta)\omega_G} \cdot \frac{\beta}{\delta}$ under collective lobbying where only one or two firms are engaged in lobbying activities in its equilibrium.

Focusing on the case where two firms have joined the industrial lobby in the initial stage, the payoff of a firm which is free-riding under the collective lobbying regime is given by $B(e^C_2)$. This is always greater than the payoff of a firm which is contributing as a part of the industrial lobby group under the collective lobbying, i.e., $B(e^C_2) - \frac{1}{2}C^C_2(e^C_2)$. Thus, being under the individual lobbying regime is better for all the firms, including a potential successful free-rider, than being under the collective lobbying regime if and only if the following condition holds:

$$B(e^I_N) - C^I_N(e^I_N) \geq B(e^C_2). \tag{34}$$

Given the levels of e^I_N and e^C_2 obtained above, as well as (32), (34) reduces to $N \geq \frac{5}{2}$. Due to our assumption that $N \geq 4$, the above condition is always satisfied. Hence, we can state

Proposition 2. *All the firms in the industry unanimously prefer the individual lob-*

[27] This unique Nash equilibrium is also the dominant strategy equilibrium.

bying regime to the collective lobbying regime.

Thus, unless some kind of institutional restriction is imposed on the lobby formation, the firms should not voluntarily collude over lobbying activities. By lobbying as separate entities, the individual firms can all achieve the best possible outcome for themselves.

While the outcome that all the firms lobby independently is the unique Nash equilibrium of the individual lobbying game, it might be more realistic to consider that this outcome is achieved through repeated interactions among the policymaker and the lobbyists, and not a result of one-shot play. Under individual lobbying, even if $\omega_P(M) < 1$ realizes at one moment of time, the number of participating firms in lobbying gradually increases and eventually $\omega_P(M) = 1$ obtains as the unique and stable equilibrium as long as there are sufficiently large number of lobbying occasions. This dynamic process through the repeated interactions, indeed, conforms to the observation that the number of participating lobbyists increases steadily over time and also that the number never declines, as is often reported in academic writings as well as in the news media (Grossman and Helpman, 2001; the Guardian, 2014).

3.3 Social Welfare and an Institutional Intervention

In the presence of environmental damages, however, the socially preferable regime may differ from the one unanimously supported by the firms in the industry. In order to achieve the best outcome for the society, it is important to know how significantly the environmental lobby is organized. If it is fully organized, the full-scale lobbying by the industry lobbyist is also socially desirable since the emission limit of (4) obtains, as is well-known in the literature (e.g., Aidt 1998). In this case, the individual lobbying outcome is most desirable. In another case where the environmental interest is significantly underrepresented by the environmental lobby group, i.e., ω_G is sufficiently low, it might be socially profitable to prevent individual lobbying from realizing. In particular, if the environmental lobby is not organized at all, the society is clearly better off by having the collective lobby regime, or even better yet by banning any type of industrial lobbying.

In finding the socially desirable lobbying regime, the levels of the social welfare under the two distinct equilibrium results need to be compared with one another. The collective lobbying regime yields a greater social welfare value than the individual lobbying regime if the following inequality holds:[28]

$$B(e_2^C) - D(e_2^C) \geq B(e_N^I) - D(e_N^I). \tag{35}$$

Given the levels of e_N^I and e_2^C, (35) reduces to

$$N \leq 2\,(1-2\theta)\left[\left[\frac{2\beta}{\delta}\left\{\theta + (1-2\theta)\omega_G\right\} - 2\theta\right] - 1\right]^{-1}. \tag{36}$$

Let us denote the right-hand side of (36) by $\bar{N}$, which is the threshold number of the firms in the regulated industry below which the collective lobbying outcome is socially preferable to the individual lobbying outcome. Thus, if the actual N is smaller than $\bar{N}$, given by the right-hand side of (36), it is beneficial for a society to institutionally prevent firms from engaging in individual lobbying.

A straight-forward comparative statics exercise shows that an increase in ω_G, which means that the environmental interest is represented in a greater scale, leads to a smaller threshold value of $\bar{N}$. Thus, it is now more likely that a more efficient emission level obtains if the industrial interest is fully represented under the individual lobbying regime. Therefore, we can state

Proposition 3. *As the organization ratio of the environmental interest increases, the individual lobbying regime is more likely to be socially desirable.*

Simple calculations also reveal that, as the marginal damage cost of the emissions, i.e., δ, increases, the collective lobbying outcome is more likely to be preferred by the society, whereas an increase in the marginal benefit of the emissions, i.e., β, leads to a case where the individual lobbying result is more likely to be preferred. In the former case, unless the environmental interest is completely reflected on the behavior of the environmental lobby group, i.e., $\omega_G = 1$, the resulting over-representation of the industrial interest under

[28] Again, for collective lobbying we focus on the case where two firms have joined the industrial lobby in the initial stage.

individual lobbying becomes even more problematic with an increase in δ. In the latter case, it is the under-representation of the industrial interest that causes more significant harm to social welfare with a larger β.

So far, we have supposed that a particular type of lobbying regime is imposed from the very outset. An alternative way for the society to control the type of an actual lobbying regime is to somehow limit the lobbyists' access to the policymaker according to their scales. More specifically, we consider the possibility that a certain third party, say, an administrative body, which is independent of the policymaker and attempts to maximize social welfare, is able to impose a minimum size requirement for a potential lobby to be qualified as a lobbyist. Even when there exists no explicit rule on the size of a participating lobbyist, the administration may help the society to develop a *de facto* standard that a policymaker does not deal with a lobbyist of a smaller scale. After all, our results above show that the outcome under collective lobbying is Pareto-inferior for all the firms to the outcome under individual lobbying, and the reality that we often have consortiums of firms to represent industrial interests collectively may suggest the working of such an implicit restriction.[29]

Here, we can easily establish the relationships between the minimum lobby size and the resulting lobby environments. If the minimum size of a single lobbyist is greater than 2 in terms of the number of firms in one lobby group, there is no industry lobby operating in our model. If it is set at somewhere between 1 and 2, there exists one industry lobby group which consists of only two firms. This essentially corresponds with the collective lobbying regime above, given its equilibrium outcome. If the minimum size is less than or equal to 1, all the firms take part in lobbying independently,[30] which results in the outcome obtained under individual lobbying.

Considering these relationships, we can conclude that if the actual N is greater than $\bar{N}$ above, the minimum size should be set at less than or equal to 1, which induces the individual lobbying outcome. On the other hand, in a case where the environmental

[29]Again, we should note that potential scale economies in forming a single lobby among multiple entities are ignored in this study. Also, we have not considered the possibility of repeated interactions among firms, which could sustain the situation with more than 2 firms in the industrial lobby as its subgame-perfect equilibrium even under collective lobbying.

[30]Note that if it is exactly one, it is the strictly dominant strategy for each firm to lobby individually.

interest is significantly underrepresented by the environmental lobby group, i.e., ω_G is sufficiently low, it might be socially beneficial to prevent individual lobbying from realizing and, accordingly, set the minimum lobbyist size high enough to induce collective lobbying or even no lobbying at all.[31] In particular, if the environmental lobby is not organized at all, the society is clearly better off by imposing a minimum size restriction which is greater than 2 in terms of a number of firms in one lobby group.

4 Concluding Remarks

In this paper, we not only endogenized the lobby participation but also analyzed the outcomes under two distinct institutional setups for the lobbying environment: collective and individual lobbying. Under collective lobbying firms first form a single interest group whereas there is no such stage under individual lobbying. The difference in the outcomes is quite striking: only a small fraction of firms engage in lobbying activities under collective lobbying, while all the firms participate in lobbying in the unique equilibrium outcome for the case of individual lobbying.

Moreover, under the collective lobbying regime, the equilibrium outcome is unanimously less preferred by all the firms to the outcome where all of them are collectively engaged in lobbying. Under the individual lobbying regime, on the other hand, every firm voluntarily chooses to lobby for a policy which benefits not just itself but those who share the common interest in having a laxer environmental regulation. Rather paradoxically, seemingly "coordinated" actions occur only when the group formation process is not precoordinated. This also implies that, although we do not include potential advantages in forming a lobby coalition, such as certain scale economies through sharing indispensable resources, a coalition might be hard to be sustained in the long term unless such scale economies are sufficiently strong.

From the social welfare perspective, however, the outcome under individual lobbying may not be inferior to the outcome under collective lobbying. If that is the case, it is beneficial for a society to institutionally prevent firms from engaging in individual

[31] The other threshold between no industrial lobbying and collective lobbying as the socially desirable case can also be found in a similar fashion to the the identification of $\bar{N}$.

lobbying, for instance, by somehow limiting the lobbyists' access to the policymaker according to their sizes.

Although our model is formulated in the context of environmental regulation, the general implications of our analytical results are not necessarily restricted to the specificity of the model. Since most of the lobbying models assume some sorts of exogenous organizations of lobbyists from the onsets, we hope that the importance of institutional conditions on policy and welfare outcomes, which we have observed in this paper, leads to more careful identifications of lobbying environments in future studies.

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