Lobbying, Information Transmission, and Unequal Representation*

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Abstract

We study the effects of unequal representation in the interest-group system on the degree of information transmission between a lobbyist and a policymaker. Employing a dynamic cheap-talk model in which the lobbyist cares instrumentally about his reputation for truthtelling, we show that the larger is the inequality, the less information can credibly be transmitted to the policymaker. We also investigate the effects of inequality on welfare and discuss the welfare effects of institutions that increase transparency but which as well, as an unintended side-effect, lower the lobbyist's incentives for truthtelling. //[Doc: Dynamic-lobbying-5.tex//

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1 Introduction

Since the 1960s, the size of the U.S. interest-group system has grown considerably, and today there are a massive number of interest groups represented in the American capital. According to one estimate, as of the early 1990s there were 91,000 lobbyists and people associated with lobbying employed in the Washington, D.C., area.[1] Also other interest-group systems, like those in Brussels and other West European capitals, are of significant size.[2]

All interests are not represented to the same extent, however. E. E. Schattschneider famously argued that "the flaw in the pluralist heaven is that the heavenly chorus sings with a strong upper-class accent" (1960, pp. 34-35). During the years, many studies have verified the existence of such a bias.[3] The bias shows up at two levels. First, on the individual level, those of higher (social, educational, income, and professional) status tend to participate more in groups than those of lower status. Second, the basis of most groups is occupational, which means that business owners and members of certain professions tend to be overrepresented. For example, a study conducted by Scholzman and Tierney (1986), here summarized by Baumgartner and Leech (1998, p. 96), found that "72 percent of those organizations having Washington representation in 1980 were either corporations or trade and business associations. An additional 8 percent were professional associations, for a combined total of 80 percent of all groups with Washington representation. This number compares with those for citizens' groups (5 percent); civil rights, social welfare, and those representing the poor (2 percent); and those representing women, the elderly, and the handicapped (1 percent)."

In this paper we study the effects of such a bias on the degree of information transmission between a lobbyist and a policymaker. We show that the larger is the bias, the less information can credibly be transmitted to the policymaker. We model lobbying as a dynamic cheap-talk game with incomplete information about the lobbyist's true objectives.[4] This model feature creates an incentive

[1] See Phillips (1995, p. 43). For other estimates of the number of lobbyists and organizations in Washington, see Petracca (1992) and Baumgartner and Leech (1998).

[2] It has been estimated that in the early 1990's, 5,000-10,000 lobbyists were working at the European Commission in Brussels (see Liebert, 1995, p. 433). In 2001, approximately 1,700 organizations were registered with the German Bundestag (see Bennedsen and Feldmann, 2002, p. 921, note 3).

[3] See, for example, the survey in Baumgartner and Leech (1998), in particular chapters five and six.

[4] There are two (not mutually inconsistent) interpretations of our assumption that the pol-

for the lobbyist to be truthful early on in the interaction with the policymaker in order to improve his reputation for truthtelling, thereby obtaining a higher degree of influence on a future policy decision. In order to keep the analysis simple and tractable, we do not incorporate more than a single lobbyist into the model. Nevertheless, thanks to the fact that the policymaker faces uncertainty about what type of lobbyist he is dealing with, we can — in a reasonable way, we believe — capture the notion of a bias in the interest-group system. We do this by taking the policymaker's prior beliefs about the lobbyist's type as a measure of how equal or unequal the representation is. That is, if the policymaker's prior beliefs suggest that, for example, it is much more likely that the lobbyist with whom he interacts represents a right-wing interest rather than a left-wing interest, our interpretation is then that this reflects a similar inequality in the actual number of lobbyists in the interest-group system.[5]

Given this interpretation, we can show that more equality in the interest-group system strengthens the lobbyist's incentives to be truthful. This shows up in two ways in our results. First, more equality weakens the requirement on the parameters that is needed for an equilibrium with some information transmission to exist. Second, within the subset of the parameter space where such an equilibrium does exist, the degree of information transmission increases with the degree of equality. The intuition for these results (which we will return to in greater detail in Section 4) has to do with the fact that the mix of types in

icymaker does not know the lobbyist's true objectives. One is that the policymaker is literally unsure about what kind of interest the lobbyist with whom he is interacting represents. We find this possibility plausible, given the very large number of lobbyists that inhabit Washington, D.C., and other political centers in the world (cf. the remarks in the introductory paragraph). The other interpretation is that the policymaker *does* know which group the lobbyist represents, but that he is unsure about that group's position on the policy in question. This, too, seems to us as a realistic possibility. As Wright (1996, p. 154) argues: "The sheer number of organizations located in Washington, D.C.—nearly 12,000—makes it virtually impossible for any public official to be familiar with the political agendas of most groups. In the agricultural policy domain alone, there are more than 200 active organizations and hundreds of recurring issues. The 1985 farm bill contained more than 160 major provisions and 18 titles. With so many possible combinations of groups and issue positions, even representatives of agricultural districts were not familiar with many of the organizations and their positions." See Wright (1996, pp. 154-156) for some further discussion and a defense of the assumption that we make. See Austen-Smith (1995) for another model of lobbying in which the lobbyist's preferences are unknown to the policymaker.

[5] This means that we effectively assume that the policymaker selects the lobbyist that he interacts with through a random draw from a pool including all lobbyist in the interest-group system. Taken literally, this is clearly unrealistic. First, the policymaker should be more able than that in identifying the type of a lobbyist that he chooses to give access. Second, there might be a selection bias due to different lobbyists' incentives to seek access (even though it is not obvious in what direction this selection bias would go). However, we expect our qualitative results to hold also under a less extreme assumption, as long as the policymaker's beliefs at least crudely reflect the actual distribution of lobbyists.

the population of lobbyists affects the degree to which the policymaker takes the lobbyist's message into account when choosing policy, which in turn determines how attractive it is for a lobbyist to deviate from a particular equilibrium.

We also study the effects of changes in the degree of equality on expected welfare (where we assume that "welfare" is given by the policymaker's payoff). Finally, we discuss the welfare effects of two institutions that lead to greater transparency (we call these "Mandatory Registration" and "Media Scrutiny") but which as well, in our environment, lower the lobbyist's incentives for truthtelling.

The main argument of this paper — that, in a dynamic environment, more equal representation facilitates credible transmission of information — is complementary to but different from an old and prominent idea (sometimes referred to as the "adversary theory of truth"[6]) that goes back at least to J. S. Mill's *On Liberty*: if any relevant piece of information favors at least one interest and if all interests have an opportunity to express their views (they all "have a voice"), then all relevant pieces information will be presented.[7] To the extent that the existence of a bias in the interest-group system makes it less likely that also the underrepresented interests have a voice, the adversary theory of truth — just like our reputational argument — lends support to the conclusion that more equal representation helps elicit the truth.[8]

Our paper is also related to the literature on cheap talk and strategic information transmission (see Crawford and Sobel, 1982, for a seminal contribution). Particularly closely related is the fairly small part of that literature that assumes that the sender and the receiver (or, in our setting, the lobbyist respectively the policymaker) interact over more than one period and that the sender has private information about his preferences. Sobel (1985) was the first to model this and to show that in such an environment the sender may care instrumentally about his reputation for truthtelling.[9] Sobel's model has been extended and

[6] See Mansbridge (1992).

[7] The idea has been studied in formal game-theoretic settings by, among others, Milgrom and Roberts (1986), Austen-Smith and Wright (1992), Dewatripont and Tirole (1999), Krishna and Morgan (2001), and Frisell (2002).

[8] One should keep in mind, however, that the adversary-theory-of-truth argument does not concern the degree of unequal representation per se, but the question whether a particular interest has a voice or not. If, for example, "obtaining a voice" can be achieved by any interest that has at least some threshold degree of representation, then further equalizing the degree of representation cannot be justified by this argument alone. This distinction could be crucial from a policy point of view.

[9] Sobel's analysis in turn draws on the work by Kreps and Wilson (1982) and Milgrom and Roberts (1982).

further examined by Benabou and Laroque (1992) and Morris (2001). In all three of these papers, however, the type space is binary; that is, the sender is assumed either to have preferences that are identical to the receiver's or to have preferences that differ from his in one particular way. In Morris's model, for example, the "enemy lobbyist" always wants, say, a left-wing policy, regardless of the true state of the world. In our model, in contrast, there are two kinds of "enemy lobbyists": one who always, regardless of the true state, wants a left-wing policy and one who always wants a right-wing policy. This extension considerably enriches the model and enables us to address questions about the effects of a bias in the interest-group system.

Finally, our paper is related to a strand of literature that models lobbying as an exercise in strategic information transmission. See, for example, Austen-Smith and Wright (1992), Potters and van Winden (1992), Lohmann (1995), Lagerlöf (1997), Grossman and Helpman (2001), and Bennedsen and Feldmann (2002).

The remainder of the paper is organized as follows. The next section describes our model, which is then analyzed in Section 3. Section 4 investigates how a change in equality affects the amount of information that is credibly transmitted in equilibrium, and it also looks at the effects on expected welfare. Section 5 discusses the welfare effects of the two institutions that we mentioned above, "Mandatory Registration" and "Media Scrutiny." Section 6 concludes. An appendix contains some proofs that are omitted from the main text.

2 The Lobbying Game

We model lobbying as a game between a lobbyist and a policymaker, in which the lobbyist has private information about a policy-relevant state of the world and about his own type. There are two possible states of the world: in a "low state" the policymaker would — given that he knew the true state — prefer a left-wing policy, whereas in a "high state" he would prefer a right-wing policy. The lobbyist's type refers to what kind of interest he represents. Here there are three possibilities: the lobbyist may represent (i) a left-wing group that regardless of the true state wants a policy that is as far left as possible, (ii) a right-wing group that regardless of the true state wants a policy that is as far right as possible, or (iii) he may be a "good" lobbyist whose interests coincide with those of the policymaker.

The game consists of two periods, and in each period the events are the same: knowing the true state for that period, the lobbyist first sends a cheap-talk message to the policymaker, whereupon the policymaker chooses a policy. Whereas the state of the world is drawn anew in the second period, the lobbyist's type is the same in the two periods. At the end of the first period, the policymaker's first-period payoff is realized, which means that he can then infer the true first-period state. Moreover, knowing the true state, the policymaker can at that time infer whether or not the lobbyist was truthful when sending his first-period message — this is the model feature that will (under some circumstances) create an incentive also for the left- and right-wing lobbyists to be truthful in period 1, in order to enhance their reputation for being a good lobbyist.

Formally, we denote the period t (for $t = 1, 2$) policy by $x_t \in [0, 1]$, the period t state by $\theta_t \in \{0, 1\}$, and the period t message by $m_t \in \{0, 1\}$. In each period, the two possible states are drawn with equal probability: $\Pr(\theta_t = 1) = 1/2$; and θ_1 and θ_2 are independent. The lobbyist learns θ_t at the beginning of period t, whereas the policymaker knows only the distribution according to which the state is drawn. The policymaker's per-period payoff is given by

$$U_{PM}(x_t, \theta_t) = -(x_t - \theta_t)^2 .$$

Only the lobbyist knows his type; the policymaker's prior beliefs about the lobbyist's type are as follows. With probability p_G the lobbyist is of type G (as in "good"), in which case his per-period payoff function is identical to the policymaker's, $U_G(x_t, \theta_t) \equiv U_{PM}(x_t, \theta_t)$. With probability p_L the lobbyist is of type L. A type-L lobbyist (L stands for "left") represents an interest that wants x_t to be as small as possible, regardless of the value of θ_t; in particular, his per-period payoff is given by $U_L(x_t) = -x_t$. Finally, with probability p_R the lobbyist is of type R (where R is short for "right"). A type-R lobbyist represents an interest that wants x_t to be as large as possible, regardless of the value of θ_t; his per-period payoff is given by $U_R(x_t) = x_t$. The probabilities p_L, p_R, and p_G are all strictly positive and satisfy $p_L + p_R + p_G = 1$. In period 1, the players discount their period 2 payoffs with the (common) discount factor $\delta \in (0, 2)$.

The sequence of events can thus be summarized as follows. (1) The lobbyist learns θ_1 and then chooses m_1. (2) The policymaker observes m_1, updates his beliefs about θ_1, and chooses x_1. (3) The players' period 1 payoffs are realized, which makes it possible for the policymaker to infer the true θ_1 and thus also whether the lobbyist's report was truthful or not. Using this information, the policymaker updates his beliefs about the lobbyist's type. (4) The lobbyist learns θ_2 and then chooses m_2. (5) The policymaker observes m_2, updates his beliefs about θ_2, and chooses x_2. (6) The players' period 2 payoffs are realized.

In the following section we will solve for the perfect Bayesian equilibria of the game described above, where this equilibrium concept is defined in the usual way: both players must make optimal decisions at all information sets given their beliefs, and these beliefs are formed using Bayes' rule whenever that is defined.

3 Analysis of the Lobbying Game

3.1 The Second Period

Let us begin the analysis by considering the players' behavior in period 2. As in any cheap-talk game, there exists an equilibrium of the period 2 game in which there is no information transmission at all, a so-called babbling equilibrium.[10] In the following, however, we will disregard all such equilibria and instead restrict our attention to equilibria in which the type-G lobbyist in both periods tells the truth with probability one, that is, equilibria in which G chooses $m_t = 0$ if $\theta_t = 0$, and $m_t = 1$ if $\theta_t = 1$.[11] Given that G reports truthfully and that the policymaker assigns a positive probability to the event that he is indeed dealing with a type-G lobbyist (i.e., that $p_G > 0$), the policymaker's decision will (at least to some extent) be made contingent on the lobbyist's message; in particular, a second-period message $m_2 = 0$ will induce a lower x_2 than will a message $m_2 = 1$. As a consequence, since reputational concerns do not matter in period 2, the type-L lobbyist always chooses $m_2 = 0$ and the type-R lobbyist always chooses $m_2 = 1$, regardless of whether the true state is low or high.

[10] To see this, suppose all three types of lobbyists, regardless of which state they have observed, "babble" by playing $m_2 = 0$ and $m_2 = 1$ with equal probability. If the policymaker (correctly) believes that this is the way L, R, and G behave, then he cannot infer any information from their messages and thus always chooses $x_2 = 1/2$, his optimal policy given the fifty-fifty prior. This in turn means that no type of lobbyist has a (strict) incentive to deviate from the babbling strategy, which confirms the policymaker's beliefs about their behavior. Accordingly, all types' sending messages that are uncorrelated with the true state and the policymaker's choosing the policy 1/2 constitute an equilibrium.

[11] We will also disregard any "mirror" equilibrium (of the period 2 game as well as of the full game) where the labels have the opposite meaning, so that, for example, $m_2 = 0$ means $\theta_2 = 1$ and $m_2 = 1$ means $\theta_2 = 0$. Clearly, since labels do not have any inherent meaning in our model, such an equilibrium will exist whenever the corresponding "normal" one does.

The policymaker realizes that the different types behave in this fashion and updates his beliefs about θ_2 accordingly, using Bayes' rule. In particular, let $\widetilde{p}_j$ (for $j = L, G, R$) denote the policymaker's updated beliefs about the lobbyist's type at the stage where he has inferred θ_1 but not yet observed m_2.[12] Then the policymaker's updated beliefs about θ_2 are given by[13,14]

$$\Pr(\theta_2 = 1 \mid m_2) = \begin{cases} \frac{\widetilde{p}_G + \widetilde{p}_R}{\widetilde{p}_G + 2\widetilde{p}_R} & \text{if } m_2 = 1 \\ \frac{\widetilde{p}_L}{\widetilde{p}_G + 2\widetilde{p}_L} & \text{if } m_2 = 0. \end{cases} \tag{1}$$

Given these beliefs, the policymaker chooses his optimal period 2 policy. Because the policymaker's payoff function is quadratic and the state equals either zero or unity, this optimal policy is identical to the probability he assigns to the event that $\theta_2 = 1$, as given by (1).

3.2 The First Period

A Partially Informative Equilibrium Let us now turn to period 1. We will, to start with, look for an equilibrium in which both L and R, also when the state is not in their favor, tell the truth with positive probability. More specifically, we want to find an equilibrium in which the lobbyist's period 1 behavior is such that G always tells the truth, and L and R tell the truth for sure when the state is in their favor and with probability λ_L, respectively λ_R, otherwise (with $\lambda_L, \lambda_R \in (0,1)$).[15]

We will call the kind of equilibrium described above a "partially informative equilibrium." Given the lobbyist's behavior in such an equilibrium, the policymaker's updated beliefs about θ_1, after having observed a message m_1, can (again using Bayes' rule) be written as

$$\Pr(\theta_1 = 1 \mid m_1) = \begin{cases} \frac{1 - p_L(1-\lambda_L)}{1 + p_R(1-\lambda_R) - p_L(1-\lambda_L)} & \text{if } m_1 = 1 \\ \frac{p_L(1-\lambda_L)}{1 + p_L(1-\lambda_L) - p_R(1-\lambda_R)} & \text{if } m_1 = 0. \end{cases} \tag{2}$$

Let us investigate the incentives to lie, respectively to tell the truth, for a type-R lobbyist who knows that $\theta_1 = 0$. If this lobbyist is untruthful and plays

[12] The probabilities $\widetilde{p}_j$ are of course endogenous to the model and will be solved for later.

[13] Here we implictly assume that $\widetilde{p}_L < 1$ (in the expression for $m_2 = 1$) respectively $\widetilde{p}_R < 1$ (in the expression for $m_2 = 0$). But these inequalities must hold given that G reports truthfully in both periods.

[14] The easiest way to verify these and the other expressions for the policymaker's updated beliefs that we use in the paper is to draw a tree diagram that graphically shows the possible outcomes and the associated probabilities. Having done this, one can readily calculate, for example, the likelihood that $\theta_2 = 1$ given that $m_2 = 1$.

[15] Formally: G chooses $m_1 = 0$ if $\theta_1 = 0$, and $m_1 = 1$ if $\theta_1 = 1$; L chooses $m_1 = 0$ if $\theta_1 = 0$, and $m_1 = 1$ with probability $\lambda_L \in (0,1)$ if $\theta_1 = 1$; and R chooses $m_1 = 1$ if $\theta_1 = 1$, and $m_1 = 0$ with probability $\lambda_R \in (0,1)$ if $\theta_1 = 0$.

$m_1 = 1$, he will in period 2 be recognized as a type-R lobbyist. If so, no information transmission is possible in that period[16] and, since the policymaker's prior assigns equal probability to the two states, the second-period policy equals 1/2. This is the disadvantage for R of lying: it deprives him of the opportunity to have an influence on the second-period policy. The advantage of lying is that this induces the policymaker to pick a first-period policy that is relatively favorable to R. In particular, that policy will equal $\Pr(\theta_1 = 1 \mid 1)$, as given by (2). Hence, the overall payoff for a type-R lobbyist who knows that $\theta_1 = 0$ and who plays $m_1 = 1$ equals

$$\frac{1 - p_L(1-\lambda_L)}{1 + p_R(1-\lambda_R) - p_L(1-\lambda_L)} + \frac{\delta}{2}. \tag{3}$$

A type-R lobbyist who knows that $\theta_1 = 0$ and who, truthfully, plays $m_1 = 0$ will (at the stage when the policymaker has inferred θ_1 but not yet observed m_2) give rise to the following posterior beliefs about his type:

$$\widetilde{p}_R = \frac{p_R\lambda_R}{p_L + p_G + p_R\lambda_R}, \qquad \widetilde{p}_G = \frac{p_G}{p_L + p_G + p_R\lambda_R}, \tag{4}$$

and $\widetilde{p}_L = 1 - \widetilde{p}_R - \widetilde{p}_G$; this can be verified by using Bayes' rule. This means that the second-period policy (recall that in the second period R always chooses $m_2 = 1$) will equal

$$\Pr(\theta_2 = 1 \mid 1) = \frac{\widetilde{p}_G + \widetilde{p}_R}{\widetilde{p}_G + 2\widetilde{p}_R} = \frac{p_G + p_R\lambda_R}{p_G + 2p_R\lambda_R}, \tag{5}$$

where the first equality follows from (1) and the second from (4). The first-period policy equals $\Pr(\theta_1 = 1 \mid 0)$, as given by (2). Hence, the overall payoff for a type-R lobbyist who knows that $\theta_1 = 0$ and who plays $m_1 = 0$ equals

$$\frac{p_L(1-\lambda_L)}{1 + p_L(1-\lambda_L) - p_R(1-\lambda_R)} + \delta\frac{p_G + p_R\lambda_R}{p_G + 2p_R\lambda_R}. \tag{6}$$

For $\lambda_R \in (0,1)$ indeed to be part of an equilibrium, R must be indifferent between being truthful and not when knowing that $\theta_1 = 0$. Setting (3) and (6) equal to each other and then rewriting, one has

$$\frac{1 - p_R(1-\lambda_R) - p_L(1-\lambda_L)}{1 - [p_R(1-\lambda_R) - p_L(1-\lambda_L)]^2} = \frac{\delta p_G}{2(p_G + 2p_R\lambda_R)}. \tag{7}$$

The left-hand side of this equation is symmetric with respect to L and R. Hence, the corresponding incentive constraint for the type-L lobbyist (i.e., that $\lambda_L \in$

[16] It is straightforward to verify that if it is common knowledge that the lobbyist is of type R (or if it is common knowledge that he is of type L), then any equilibrium must be babbling.

$(0,1))$ must lead to an equation with the same left-hand side as in (7); in particular, (7) and the requirement that $\lambda_L \in (0,1)$ imply that $p_R\lambda_R = p_L\lambda_L$ (see the denominator of the right-hand side of (7)). By using this equality to eliminate λ_R from (7) and then solving the resulting expression for λ_L, one has

$$\lambda_L^* = \frac{\sqrt{p_G}}{2p_L}\left[\sqrt{\frac{\delta}{2}\left[1-(p_R-p_L)^2\right]}-\sqrt{p_G}\right]. \tag{8}$$

And λ_R^* is easily obtained from (8) through the relationship $\lambda_R^* = p_L\lambda_L^*/p_R$.

One can verify that both λ_L^* and λ_R^* are always below unity. In order to have $\lambda_L^* > 0$ (or, equivalently, $\lambda_R^* > 0$),[17] we need the following condition:[18] $p_L > \varphi(p_R, \delta)$, where

$$\varphi(p_R,\delta) \equiv \frac{1}{\delta}\left[1+\delta p_R - \sqrt{(1-\delta)^2 + 4\delta p_R}\right]. \tag{9}$$

So far we have checked only one of the type-R lobbyist's two incentive constraints. The other incentive constraint requires that R must want to play $m_1 = m_H$ with probability one if knowing that $\theta_1 = 1$. One can easily verify, however, that this is always satisfied. Moreover, the two incentive constraints for L are satisfied exactly when the ones for R are.

The following proposition sums up the results.

Proposition 1. *A partially informative equilibrium exists if and only if* $p_L > \varphi(p_R,\delta)$, *where* $\varphi(p_R,\delta)$ *is given by (9). In such an equilibrium* $(\lambda_L, \lambda_R) = (\lambda_L^*, \lambda_R^*)$, *where* $\lambda_R^* = p_L\lambda_L^*/p_R$ *and* λ_L^* *is given by (8).*

We will shortly return to a further discussion of this kind of equilibrium.

A Non-Informative Equilibrium Next we will look for an equilibrium in which neither L nor R reports truthfully in period 1, but G does. Formally, we want to find an equilibrium in which G reports $m_1 = 0$ if $\theta_1 = 0$, and $m_1 = 1$ if $\theta_1 = 1$; and L (respectively, R) reports $m_1 = 0$ (respectively, $m_1 = 1$) regardless of the state. Although the name is a bit of a misnomer, we will call this kind of equilibrium a "non-informative equilibrium," since here only the type-G lobbyist transmits any information.

[17] The fact that the requirements $\lambda^L > 0$ and $\lambda^R > 0$ are satisfied for exactly the same parameter values is due to the assumption that the type-L and type-R lobbyists have linear payoff functions: both of them care only about the distance between the policy induced by a report $m_t = 0$ and the policy induced by a report $m_t = 1$.

[18] This condition was obtained by substituting $p_G = 1 - p_L - p_R$ into (8) and then solving the inequality $\lambda_L^* > 0$ for p_L.

In order to see under what circumstances a non-informative equilibrium exists, consider the incentives for a type-R lobbyist who knows that $\theta_1 = 0$ to follow the equilibrium and lie (by playing $m_1 = 1$), respectively to deviate and tell the truth (by playing $m_1 = 0$). If this lobbyist lies, he will in period 2 be recognized as a type-R lobbyist. As a consequence, any information transmission in period 2 is impossible[19] and the second-period policy, which also is R's payoff, equals 1/2. R's first-period payoff if he lies is given by

$$\frac{p_R + p_G}{2p_R + p_G} = \frac{1 - p_L}{1 + p_R - p_L},$$

where these expressions simply are the policymaker's updated belief that the state is high upon observing a message $m_1 = 1$, given the equilibrium behavior of L, R, and G (the first expression was obtained by applying Bayes' rule and the second by using the identity $p_G = 1 - p_L - p_R$).

Suppose now instead that R deviates and tells the truth in the first period. Then the policymaker will, at the time when his first-period payoff has been realized, think he is dealing with a type-R lobbyist with probability zero. Hence, when R in the second period sends the message $m_2 = 1$, the policymaker will infer that this must come from a type-G lobbyist (since a type-L lobbyist always plays $m_2 = 0$) and accordingly set the second-period policy, which also is R's second-period payoff, equal to 1. R's first-period payoff if he deviates equals the policymaker's updated belief that the state is high upon observing a message $m_1 = 0$, given the equilibrium behavior of the three types of lobbyist:

$$\frac{p_L}{2p_L + p_G} = \frac{p_L}{1 - (p_R - p_L)}$$

(where again the first expression was obtained by applying Bayes' rule and the second by using $p_G = 1 - p_L - p_R$).

In sum, R does not have an incentive to deviate from the prescribed first-period behavior if

$$\frac{1 - p_L}{1 + p_R - p_L} + \frac{\delta}{2} \geq \frac{p_L}{1 - (p_R - p_L)} + \delta \Leftrightarrow \frac{1 - p_L - p_R}{1 - (p_R - p_L)^2} \geq \frac{\delta}{2} \qquad (10)$$

The latter inequality, which is symmetric with respect to p_L and p_R, can be rewritten as $p_L \leq \varphi(p_R, \delta)$, where $\varphi(p_R, \delta)$ is as defined in (9). Because of the symmetry that we just noted, also the corresponding incentive constraint for L is satisfied exactly when $p_L \leq \varphi(p_R, \delta)$. Moreover, it is quite clear that neither

[19] See footnote 16.

L nor R wants to deviate from a non-informative equilibrium when knowing that the state is in their favor.

We thus have the following result.

Proposition 2. *A non-informative equilibrium exists if and only if* $p_L \leq \varphi(p_R, \delta)$, *where* $\varphi(p_R, \delta)$ *is given by (9).*

Other Equilibria Can there exist other (non-babbling) equilibria than the non-informative and partially informative ones? One possibility would be that, in period 1, only one of L and R is truthful with positive probability when the state is against him, and the other always reports that the state is in his favor (that is, in terms of the notation used earlier, either $\lambda_L > 0$ and $\lambda_R = 0$, or $\lambda_L = 0$ and $\lambda_R > 0$). In the appendix (Lemma A1), however, we prove that this behavior cannot be part of an equilibrium. The only remaining possibility is that both L and R are truthful with probability one in the first period (i.e., $\lambda_L = \lambda_R = 1$). But this cannot be part of an equilibrium either (see Lemma A2 in the appendix).[20] Hence, in the rest of the paper we will discuss the players' (and, in particular, the lobbyist's) behavior in a non-informative and in a partially informative equilibrium.

4 Effects of a Change in Equality

The analysis of the previous section tells us that whether we can sustain an equilibrium in which L and R transmit some information in period 1 depends on how p_L relates to the function $\varphi(p_R, \delta)$, which was defined in (9). Figure 1 plots the graph of φ in the (p_L, p_R)-space for a given p_G and δ.[21] In the region southwest of the graph of φ a non-informative equilibrium exists (see Proposition 2), and in the shadowed region northeast of this graph a partially informative equilibrium exists (see Proposition 1). In the following we will discuss how changes in the relative magnitude of p_L and p_R, for a fixed p_G, affect the degree of information transmission and social welfare.

[20] The cases we have mentioned cover all possible equilibria in which G tells the truth with probability one in both periods. There are additional equilibria in which G does not do this (for example, the babbling equilibria discussed in footnote 10). From our perspective, however, these other equilibria are less interesting as they involve a smaller amount of information transmission.

[21] A change in p_G can in terms of this figure be thought of as a shift of a straight line with slope -1 (as the one drawn in the figure). It can readily be verified that, consistent with the way the figure is drawn, $\varphi(p_R, \delta)$ is decreasing in both its arguments, and it is convex in p_R. Moreover, $\varphi(0, \delta) = 1$ and $\varphi(1, \delta) = 0$ for all δ, and the function has the following symmetry property: $\varphi((2-\delta)/4, \delta) = (2-\delta)/4$.

Information Transmission Let us first consider the effects on the degree of information transmission. From Figure 1 we see that, due to the fact that φ is convex in p_R, the requirement on the parameters for a partially informative equilibrium to exist is weaker the more *equal* p_L and p_R are. In particular, if $p_L = p_R$, a partially informative equilibrium exists for all $p_G < \delta/2$; but if p_L is sufficiently close to $(1 - p_G)$ and p_H is sufficiently close to zero (or vice versa), a partially informative equilibrium exists only for p_G's very close to zero. As we mentioned in the introduction, we will interpret the closeness of p_L and p_R as a measure of the degree of equal representation in the interest-group system or, put more briefly, as a measure of *equality*. To be more exact, let us define $\Delta \equiv (p_R - p_L)^2$. In terms of this notation, more equality in the sense of a lower Δ is conducive to the existence of a partially informative equilibrium.

Not only is more equality conducive to information transmission in that it weakens the requirement on the parameters for a partially informative equilibrium to exist, equality is good for information transmission also *within* the region in which such an equilibrium exists. To see this, let us calculate the ex ante probability of truthtelling in the first period, given that a partially informative equilibrium is played:

$$p_G + p_L\left(\frac{1}{2} + \frac{\lambda_L^*}{2}\right) + p_R\left(\frac{1}{2} + \frac{\lambda_R^*}{2}\right) = \frac{1 + \sqrt{\frac{\delta p_G(1-\Delta)}{2}}}{2}.$$

This expression is decreasing in Δ: more equality gives rise to more truthtelling.[22]

We sum up the above results in the following proposition.

Proposition 3. *Equality is conducive to information transmission in the sense that: (i) more equality weakens the requirement on the parameters needed for a partially informative equilibrium to exist; and (ii), given that such an equilibrium exists, the degree of information transmission in period 1 increases with the degree of equality.*

The intuition behind these results is a little bit involved, and in order to understand it better we will initially explain it in somewhat simplified terms. Consider the incentives for, say, R to "invest" in truthtelling in the first period by reporting $m_1 = 0$ when the state is against him (i.e., when $\theta_1 = 0$). The

[22] Calculating the ex ante probability of truthtelling in the *second* period yields $p_G + p_L\frac{1}{2} + p_R\frac{1}{2} = (1 + p_G)/2$, which is independent of Δ (or, more accurately, a function only of the sum of p_L and p_R).

"cost" of this investment is determined by the extent to which the policymaker takes the message $m_1 = 0$ into account when choosing the first period policy. This, in turn, depends on the number of type-L lobbyists in the population: the investment cost is lower if there are many type-L lobbyists, since then the policymaker discounts the message more heavily. Symmetrically, the cost of investing in truthtelling for a type-L lobbyist who knows that $\theta_1 = 1$ is lower the more type-R lobbyists there are. Thus, in order to get as much truthtelling as possible from both the type-L's and the type-R's, we need "many of both types" or, in other words, an equal number of the two types.

The above explanation hopefully provides some insight into why equality is conducive to information transmission. Still, it focuses on only one particular effect while abstracting from others; in particular, it does not say anything about how the payoff from *not* being truthful is affected by a change in the number of the opposite type, and it also ignores the effect on the second-period payoff. In order to get a deeper understanding of the logic, let us therefore study in greater detail the condition needed for a non-informative equilibrium to exist. The logic for this equilibrium is the most transparent one, since the algebra needed to derive it is less complex than that for a partially informative equilibrium; in particular, in a non-informative equilibrium (or if deviating from such an equilibrium), only the first-period payoff of L and R depends on p_L or p_R.[23]

Thus, consider again the situation where R, in a non-informative equilibrium, knows that $\theta_1 = 0$ and is about to choose whether to lie or to tell the truth. By using the identity $p_L = 1 - p_R - p_G$, we can rewrite R's equilibrium payoff and his payoff if deviating so that these expressions are functions of p_R and p_G but not p_L. Doing this yields (cf. the expressions in inequality (10))

$$U^{eq} \equiv \frac{p_R + p_G}{2p_R + p_G} + \frac{\delta}{2} \qquad \text{and} \qquad U^{dev} \equiv \frac{1 - p_R - p_G}{2 - 2p_R - p_G} + \delta.$$

The first term of U^{eq} is the policymaker's chosen policy after having observed a message from the lobbyist claiming that the state is high. For a fixed p_G, this policy takes values between $1/(2 - p_G)$ and 1, and its exact magnitude depends on the number of type-R's in the population of lobbyists: as the number of type-R's becomes larger, the policymaker discounts the informational value of

[23] Therefore, studying the non-informative equilibrium is a good way of understanding also the questions why more equality is conducive to the existence of a partially informative equilibrium and why, given that such an equilibrium exists, more equality increases the degree of first-period truthtelling.

the message more and thus chooses a lower policy. Hence, U^{eq} is decreasing in p_R. The first term of U^{dev}, which takes values between 0 and $(1 - p_G) / (2 - p_G)$, is the policymaker's chosen policy after having observed a message from the lobbyist claiming that the state is low. In equilibrium, such a message is sent only by type-L and type-G lobbyists, and the less common the type-L's (and thus the more common the type-R's) are in the population, the more the policymaker will rely on the message and the lower policy he will choose. Hence, also U^{dev} is decreasing in p_R.

The graphs of U^{eq} and U^{dev} are depicted in Figure 2. Note that the graphs relate to each other in a symmetric fashion.[24] The key observation to make — and the fundamental reason why inequality is conducive to the existence of a non-informative equilibrium — is that U^{eq} is *convex* in p_R: for a marginal increase in the number of type-R lobbyists in the population, the downward adjustment of the policy is larger for smaller than for higher values of p_R; this is simply a property of Bayes' rule. Because of the symmetric relationship between U^{eq} and U^{dev}, the graph of U^{dev} must be *concave* in p_R. It is this difference in curvature that explains why the equilibrium requirement $U^{eq} \geq U^{dev}$ is less likely to hold for values of p_R close to $(1 - p_G)/2$ than it is for p_R's close to zero or $(1 - p_G)$. For a high degree of equality, the mix of types in the population of lobbyists induces policy decisions that make it relatively attractive to deviate from the non-informative equilibrium.

Welfare Let us now consider the effects of a change in equality on welfare. We define "welfare" as being identical to the policymaker's payoff, so that per-period welfare is given by $W(x_t, \theta_t) = -(x_t - \theta_t)^2$. Even though equality, as we saw above, is conducive to information transmission, this does not necessarily mean that it is welfare-enhancing. In fact, assuming that we are in the subset of the parameter space where a partially informative equilibrium exists (and that it also is played), there are two forces that work in opposite directions. First, as we just mentioned, more equality makes the first-period messages of the type-L and type-R lobbyists more informative, which is good for welfare. Second, more equality (as we have defined it in this paper) means that there is greater uncertainty about which type of lobbyist the policymaker is facing, and this has a negative impact on (expected) welfare.

[24] This is because of the symmetry of the model: a parameter configuration $(p_L, p_H, p_G) = (p', p'', p_G)$ is just the mirror image of the configuration $(p_L, p_H, p_G) = (p'', p', p_G)$.

In order to see which one of these effects is the strongest, let us calculate the expected welfare for each of the two periods in a partially informative equilibrium. Doing this for period 1 yields (see Lemma A3 in the appendix)

$$EW_1^{PI} = -\frac{1}{4} + \frac{\delta p_G}{8}.$$

That is, in the first period, the two effects discussed above cancel each other out: the expected first-period welfare is *independent* of p_R and p_L (or, more accurately, it depends only on their sum, $p_R + p_L$). As one would expect, however, EW_1^{PI} is increasing in p_G (since G is always truthful) and in δ (since a larger δ induces L and R to be more truthful).

Next, calculating the expected welfare for period 2 yields (see Lemma A4 in the appendix)

$$EW_2^{PI} = -\frac{1}{4} + \frac{p_G^2}{8(1-\Delta)} + \frac{p_G^2}{8\sqrt{\frac{p_G\delta(1-\Delta)}{2}}}.$$

Hence, the expected second-period welfare is *decreasing* in the degree of equality. Given the discussion above, this should hardly come as a surprise: since in period 2 there is no reputation effect that can be strengthened by an increase in equality, only the second, negative effect (i.e., more equality yields more uncertainty) matters.

Thus, the overall effect on expected welfare of an increase in equality is negative. The following proposition states this result.[25]

Proposition 4. *Suppose that a partially informative equilibrium is played. Then overall expected welfare is decreasing in the degree of equality.*

5 Mandatory Registration and Media Scrutiny

A key assumption of our analysis is that the policymaker faces uncertainty about the true interests of the lobbyist. In reality, the degree to which policymakers know the identity of the employers of any lobbyists that they are confronted with should depend on, among other things, regulatory and other kinds of institutions. For example, in the United States, Title III of the Legislative Reorganization Act (known as the Federal Regulation of Lobbying Act) of 1946 requires that individuals and groups that are accepting payment for the

[25] One can show that the same qualitative result holds with the following linear welfare function: $W(x_t, \theta_t) = -|x_t - \theta_t|$. See Lagerlöf and Frisell (2004).

purpose of influencing Congress must register with the clerk of the House or the secretary of the Senate.[26] This regulation has sometimes been criticized for being ambiguous on the question who exactly is required to register and who is not; as a consequence, it is not clear that all those who we would think of as being "lobbyists" actually register. Nevertheless, the presence of such a requirement should at least work in the direction of greater transparency. The media is another institution that plausibly could affect the degree of public knowledge about which interests lobbyists represent.

To the extent that institutions like these reduce the amount of uncertainty about the lobbyists' true interests, are they also welfare-enhancing? The analysis of Section 3 suggests one reason why they may in fact be *detrimental* to welfare. Namely, it is this uncertainty that disciplines the type-L and type-R lobbyists' first-period behavior and induces them to be truthful with positive probability. There is, on the other hand, also a positive effect associated with making the lobbyist's interests known: on those occasions when the lobbyist in fact is "good," knowing this will be valuable because then the policymaker can take the lobbyist's message fully into account when choosing policy.

In the following we will investigate which of these effects is the strongest. We do this by comparing the expected welfare in the partially informative equilibrium of our lobbying game with the expected welfare levels in two benchmarks, both of which are meant to, at least crudely, capture institutions such as the ones discussed above. Our first benchmark, or institution, we call "Mandatory Registration." Under this institution, the identity of the lobbyist becomes commonly known at the outset of the game. The expected single-period welfare in such a situation is $-\frac{1}{4}(p_L + p_R) = -\frac{1}{4}(1 - p_G)$. Hence, expected overall welfare is

$$-\frac{(1-p_G)(1+\delta)}{4}.$$

One can show that this level of expected welfare is always higher than the expected welfare in a partially informative equilibrium.[27] This result is perhaps not very surprising. After all, knowing the identity of the lobbyist from the very beginning of the game should be quite useful.

Our second institution we call "Media Scrutiny." Relative to the first bench-

[26] See, for example, Wright (1996, pp. 32-36).

[27] The proof of this as well as the other claims to be made in this section can be found in Lagerlöf and Frisell (2004).

mark, here the information is revealed at a later stage. In particular, under Media Scrutiny the identity of the lobbyist is made known to the policymaker (say, by an investigative journalist) at the end of period 1, and it is common knowledge that this will happen. The expected first-period welfare in such a situation is the same as in the non-informative equilibrium, which one can show is equal to $-1/4 + p_G^2/\left[4\left(1-\Delta\right)\right]$. The expected second-period welfare is given by $-\left(p_L + p_R\right)/4 = -\left(1-p_G\right)/4$. Hence, expected overall welfare is

$$-\frac{1}{4} + \frac{p_G^2}{4\left(1-\Delta\right)} - \frac{\delta\left(1-p_G\right)}{4}$$

(which, unsurprisingly, is lower than expected overall welfare under Mandatory Registration). Although one may think that the institution Media Scrutiny should be easier to beat than that of Mandatory Registration, one can show that also this institution dominates the partially informative equilibrium. Apparently, at least in our simple model, the negative effect (i.e., less information transmission in the first period) is dominated by the positive one (i.e., when the lobbyist is of type G, knowing this is valuable).

We summarize the above results in the following observation.

Observation 1. *Mandatory Registration yields higher overall expected welfare than Media Scrutiny. Moreover, Mandatory Registration and Media Scrutiny both yield higher overall expected welfare than the partially informative equilibrium.*

6 Conclusions

In this paper we have developed a model of informational lobbying and reputation building that builds on previous work by Sobel (1985). In contrast to Sobel (1985) and other previous papers, we assumed that in the population of lobbyists there are those who represent left-wing interests as well as those who represent right-wing interests, and the number of each type is arbitrary. The policymaker does not know the type of the lobbyist with whom he interacts, but his beliefs about this reflect the relative numbers of types in the population. This modeling framework enabled us to ask how a change in the relative number of left- and right-wing lobbyists affects the lobbying behavior and the policy outcome.

The main insight from the analysis (succinctly summarized by Figure 1) is that a more equal representation of the left- and the right-wing interests facilitates credible transmission of information. The prediction that a more equal mix of left- and right-wing lobbyists gives rise to more information transmission is in principle testable, either by using field data or by designing and running an experiment. The prediction also lends some support for the normative concern expressed by many commentators about the fact that certain groups are much better represented than others: a larger bias in our model means that the policymaker's (first-period) decision will be less informed by the lobbyist's private information. We also, however, pointed to a limitation to this argument: a larger bias (as this is interpreted in our model) means that the policymaker faces *less* uncertainty about which type of lobbyist he is interacting with; as a consequence, expected welfare actually *increases* as the bias becomes larger.

A common concern about lobbying in legislatures and other decision making bodies is the lack of transparency. This has lead the U.S. to introduce regulation that requires active lobbyists to register, and other countries (for example the U.K.; see Liebert, 1995, p. 432) have considered doing this. To the extent that such regulation does increase transparency in that it reduces the amount of uncertainty on the part of the legislators about the lobbyists' true interests, the analysis of this paper suggests that the transparency comes at a cost: it is the uncertainty that gives rise to the reputation effect and which disciplines the lobbyists' behavior and induces them to be relatively truthful. We showed, however, that — at least in our relatively simple model — the benefits with transparency always exceed this cost. It may be an interesting topic for future work to investigate how general this conclusion is.

Appendix

Lemma A1. *An equilibrium in which the types behave as follows does not exist: G chooses $m_1 = 0$ if $\theta_1 = 0$, and $m_1 = 1$ if $\theta_1 = 1$; L chooses $m_1 = 0$ regardless of whether $\theta_1 = 0$ or $\theta_1 = 1$; and R chooses $m_1 = 1$ with probability one if $\theta_1 = 1$, and $m_1 = 0$ with probability $\xi \in (0, 1)$ if $\theta_1 = 0$.*

Proof. First note that, given the stated behavior, the first-period policy after a message $m_1 = 0$, respectively $m_1 = 1$, is given by

$$\frac{p_L}{2p_L + p_G + \xi p_R} \qquad \text{and} \qquad \frac{p_G + p_R}{p_G + (2 - \xi) p_R}.$$

Now consider the period 1 incentives for R when knowing that $\theta_1 = 0$. If R tells the truth in the first period ($m_1 = 0$) and then optimally reports $m_2 = 1$ in the second, his overall payoff equals

$$\frac{p_L}{2p_L + p_G + \xi p_R} + \delta \frac{\widetilde{p}_G + \widetilde{p}_R}{\widetilde{p}_G + 2\widetilde{p}_R} = \frac{p_L}{2p_L + p_G + \xi p_R} + \delta \frac{p_G + \xi p_R}{p_G + 2\xi p_R}. \tag{11}$$

Here, the second term before the equality sign uses (1), and the second term after the equality sign uses the fact that $\widetilde{p}_G = p_G / (p_L + p_G + \xi p_R)$ and $\widetilde{p}_R = \xi p_R / (p_L + p_G + \xi p_R)$. If instead R lies in the first period ($m_1 = 1$), he will in the second period be recognized as the R-type ($\widetilde{p}_R = 1$). Thus, his overall payoff then equals

$$\frac{p_G + p_R}{p_G + (2 - \xi) p_R} + \frac{\delta}{2}. \tag{12}$$

Setting (11) equal to (12), as $\xi \in (0, 1)$ requires, we have

$$\frac{p_L}{2p_L + p_G + \xi p_R} - \frac{p_G + p_R}{p_G + (2 - \xi) p_R} = \frac{\delta}{2} - \delta \frac{p_G + \xi p_R}{p_G + 2\xi p_R}. \tag{13}$$

Next consider the period 1 incentives for L when knowing that $\theta_1 = 1$. If L follows the prescribed behavior and chooses $m_1 = 0$, he will in period 2 be recognized as the L-type. Thus, his overall payoff equals

$$-\frac{p_L}{2p_L + p_G + \xi p_R} - \frac{\delta}{2}.$$

If L deviates and plays $m_1 = 1$, he will in period 2 be thought of as being the L-type with zero probability; hence, by then sending the message $m_2 = 0$, he can induce the policymaker to set the second-period policy equal to zero. His overall payoff is therefore given by $-(p_G + p_R) / [p_G + (2 - \xi) p_R]$. In order for L not to have an incentive to deviate from the prescribed behavior we must thus have

$$\begin{aligned} -\frac{p_L}{2p_L + p_G + \xi p_R} - \frac{\delta}{2} &\geq -\frac{p_G + p_R}{p_G + (2 - \xi) p_R} \Leftrightarrow \\ \frac{p_L}{2p_L + p_G + \xi p_R} - \frac{p_G + p_R}{p_G + (2 - \xi) p_R} &\leq -\frac{\delta}{2}. \end{aligned}$$

Using (13) to eliminate the left-hand side of this inequality and then rewriting, we have $1 \leq (p_G + \xi p_R) / (p_G + 2\xi p_R)$, which is impossible. $\square$

Lemma A2. *An equilibrium in which all three types choose $m_1 = 0$ if $\theta_1 = 0$, and $m_1 = 1$ if $\theta_1 = 1$, does not exist.*

Proof. It suffices to show that R has an incentive to deviate from his prescribed behavior $m_1 = 0$ if $\theta_1 = 0$. If R knows that $\theta_1 = 0$ and follows the prescribed behavior, then $x_1 = 0$ (since all types of lobbyists are truthful, the policymaker follows their advice). In period 2, R will report $m_2 = 1$ regardless of which state he has observed. Observing this message, the policymaker chooses x_2 according to (1), but with $\widetilde{p}_G = p_G$ and $\widetilde{p}_R = p_R$ (since all types are truthful in period 1, the policymaker does not update his prior beliefs about the lobbyist's type). Thus, if knowing that $\theta_1 = 0$ and following his prescribed strategy, R gets the overall payoff $\delta\,(p_G + p_R)\,/\,(p_G + 2p_R)$. If instead R deviates and chooses $m_1 = 1$, then $x_1 = 1$. Since this leads to an out-of-equilibrium event, the policymaker's beliefs will not be determined by Bayes' rule. Let us suppose that his beliefs are the worst ones possible from R's point of view, namely $\widetilde{p}_R = 1$ (if this nevertheless gives R an incentive to deviate, then clearly we have proven the claim in the lemma). This means that there cannot be any information transmission in period 2, so $x_2 = 1/2$. Summing up, R has an incentive to deviate if

$$\delta \frac{p_G + p_R}{p_G + 2p_R} < 1 + \delta \frac{1}{2}.$$

One can easily verify that this holds for all $\delta \in [0, 2]$. □

Lemma A3. *Expected first-period welfare in a partially informative equilibrium is given by $EW_1^{PI} = -1/4 + \delta p_G/8$.*

Proof. There are four possible realizations of (θ_1, m_1):

$$(\theta_1, m_1) \in \{(0,0), (1,0), (0,1), (1,1)\}.$$

The event $(1,1)$ happens with probability $\frac{1}{2}\left[p_R + p_G + p_L \lambda_L^*\right]$, in which case welfare is (here, as well as in the expressions that follow, we make use of (2))

$$-\left(1 - \frac{1 - p_L\,(1 - \lambda_L^*)}{1 + p_R\,(1 - \lambda_R^*) - p_L\,(1 - \lambda_L^*)}\right)^2 = -\left(\frac{p_R\,(1 - \lambda_R^*)}{1 + p_R\,(1 - \lambda_R^*) - p_L\,(1 - \lambda_L^*)}\right)^2.$$

The event $(0,1)$ happens with probability $\frac{1}{2} p_R\,(1 - \lambda_R^*)$, in which case welfare is

$$-\left(\frac{1 - p_L\,(1 - \lambda_L^*)}{1 + p_R\,(1 - \lambda_R^*) - p_L\,(1 - \lambda_L^*)}\right)^2.$$

By symmetry, the event $(0,0)$ happens with probability $\frac{1}{2}\left[p_R\lambda_R^* + p_G + p_L\right]$, in which case welfare is

$$-\left(\frac{p_L\left(1-\lambda_L^*\right)}{1+p_L\left(1-\lambda_L^*\right)-p_R\left(1-\lambda_R^*\right)}\right)^2.$$

Finally, again by symmetry, the event $(1,0)$ happens with probability $\frac{1}{2}p_L\left(1-\lambda_L^*\right)$, in which case welfare is

$$-\left(\frac{1-p_R\left(1-\lambda_R^*\right)}{1+p_L\left(1-\lambda_L^*\right)-p_R\left(1-\lambda_R^*\right)}\right)^2.$$

Hence, expected first-period welfare can be written as

$$\begin{aligned}
EW_1^{PI} &= -\frac{1}{2}\left[p_R + p_G + p_L\lambda_L^*\right]\left(\frac{p_R\left(1-\lambda_R^*\right)}{1+p_R\left(1-\lambda_R^*\right)-p_L\left(1-\lambda_L^*\right)}\right)^2 \\
&\quad -\frac{1}{2}p_R\left(1-\lambda_R^*\right)\left(\frac{1-p_L\left(1-\lambda_L^*\right)}{1+p_R\left(1-\lambda_R^*\right)-p_L\left(1-\lambda_L^*\right)}\right)^2 \\
&\quad -\frac{1}{2}\left[p_R\lambda_R^* + p_G + p_L\right]\left(\frac{p_L\left(1-\lambda_L^*\right)}{1+p_L\left(1-\lambda_L^*\right)-p_R\left(1-\lambda_R^*\right)}\right)^2 \\
&\quad -\frac{1}{2}p_L\left(1-\lambda_L^*\right)\left(\frac{1-p_R\left(1-\lambda_R^*\right)}{1+p_L\left(1-\lambda_L^*\right)-p_R\left(1-\lambda_R^*\right)}\right)^2.
\end{aligned}$$

Using $p_R\lambda_R^* = p_L\lambda_L^*$ and $p_G = 1-p_R-p_L$, this simplifies to

$$\begin{aligned}
EW_1^{PI} &= -\frac{1}{2}\left[1-p_L\left(1-\lambda_L^*\right)\right]\left(\frac{p_R-p_L\lambda_L^*}{1+p_R-p_L}\right)^2 - \frac{1}{2}\left[p_R-p_L\lambda_L^*\right]\left(\frac{1-p_L\left(1-\lambda_L^*\right)}{1+p_R-p_L}\right)^2 \\
&\quad -\frac{1}{2}\left[1-p_R+p_L\lambda_L^*\right]\left(\frac{p_L\left(1-\lambda_L^*\right)}{1+p_L-p_R}\right)^2 - \frac{1}{2}p_L\left(1-\lambda_L^*\right)\left(\frac{1-p_R+p_L\lambda_L^*}{1+p_L-p_R}\right)^2 \\
&= -\frac{\left[1-p_L\left(1-\lambda_L^*\right)\right]\left[p_R-p_L\lambda_L^*\right]}{2\left(1+p_R-p_L\right)} - \frac{\left[1-p_R+p_L\lambda_L^*\right]p_L\left(1-\lambda_L^*\right)}{2\left(1+p_L-p_R\right)} \\
&= -\frac{\left(1-p_L\right)p_R - p_Gp_L\lambda_L^* - \left(p_L\lambda_L^*\right)^2}{2\left(1+p_R-p_L\right)} - \frac{\left(1-p_R\right)p_L - p_Gp_L\lambda_L^* - \left(p_L\lambda_L^*\right)^2}{2\left(1+p_L-p_R\right)}.
\end{aligned}$$

Multiplying the first ratio by $\left(1+p_L-p_R\right)$, the second by $\left(1+p_R-p_L\right)$, and then simplifying, one has

$$EW_1^{PI} = -\frac{p_L+p_R-p_R^2-p_L^2-2p_L\lambda_L^*\left(p_G+p_L\lambda_L^*\right)}{2\left[1-\left(p_R-p_L\right)^2\right]}.$$

By using the definition of λ_L^* (see (8)) and by performing some straightforward calculations, one can show that

$$2p_L\lambda_L^*\left[p_G+p_L\lambda_L^*\right] = \frac{p_G}{2}\left\{\frac{\delta}{2}\left[1-\left(p_R-p_L\right)^2\right]-p_G\right\}.$$

Plugging this into the above expression for EW_1^{PI} and then simplifying, one has

$$\begin{aligned} EW_1^{PI} &= -\frac{2\left(p_L + p_R - p_R^2 - p_L^2\right) - p_G\left\{\frac{\delta}{2}\left[1-(p_R-p_L)^2\right] - p_G\right\}}{4\left[1-(p_R-p_L)^2\right]} \\ &= -\frac{2\left(p_L + p_R - p_R^2 - p_L^2\right) + (1-p_L-p_R)^2 - \frac{\delta p_G}{2}\left[1-(p_R-p_L)^2\right]}{4\left[1-(p_R-p_L)^2\right]} \\ &= -\frac{1-(p_R-p_L)^2 - \frac{\delta p_G}{2}\left[1-(p_R-p_L)^2\right]}{4\left[1-(p_R-p_L)^2\right]}, \end{aligned}$$

which in turn simplifies to the expression in the lemma. □

Lemma A4. *Expected second-period welfare in a partially informative equilibrium is given by*

$$EW_2^{PI} = -\frac{1}{4} + \frac{p_G^2}{8\left[1-(p_R-p_L)^2\right]} + \frac{p_G^2}{8\sqrt{\frac{p_G\delta}{2}\left[1-(p_R-p_L)^2\right]}}.$$

Proof. If either the L-type or R-type was drawn in the first period and the state was against this lobbyist and he chose to lie, then the lobbyist's type will be known in period 2; hence, there can be no information transmission in period 2, so welfare is $-1/4$. This happens with probability $\frac{1}{2}p_L\left(1-\lambda_L^*\right) + \frac{1}{2}p_R\left(1-\lambda_R^*\right)$.

If the above event does not happen, then there will be some information transmission in period 2. There are eight possible events. Four of these have $m_2 = 1$:

$$(\theta_1, \theta_2, m_2) \in \{(0,1,1), (1,1,1), (0,0,1), (1,0,1)\}$$

(the remaining four are identical to those above but with $m_2 = 0$). The event $(0,1,1)$ happens with probability $\frac{1}{4}p_G + \frac{1}{4}p_R\lambda_R^*$, in which case second-period welfare is (here, as well as in the corresponding expression for the next event, we make use of (5))

$$-\left(1 - \frac{p_G + p_R\lambda_R^*}{p_G + 2p_R\lambda_R^*}\right)^2 = -\left(\frac{p_R\lambda_R^*}{p_G + 2p_R\lambda_R^*}\right)^2.$$

The event $(0,0,1)$ happens with probability $\frac{1}{4}p_R\lambda_R^*$, in which case second-period welfare is

$$-\left(\frac{p_G + p_R\lambda_R^*}{p_G + 2p_R\lambda_R^*}\right)^2.$$

The event $(1,1,1)$ happens with probability $\frac{1}{4}p_G + \frac{1}{4}p_R$, in which case second-period welfare is (here, as well as in the corresponding expression for the next event, we make use of (1) and the fact that $\widetilde{p}_i = p_i/\left(p_L\lambda_L^* + p_G + 2p_L\right)$ for $i = G, R$)

$$-\left(1 - \frac{p_G + p_R}{p_G + 2p_R}\right)^2 = -\frac{1}{4}\left(1 - \frac{p_G}{p_G + 2p_R}\right)^2.$$

The event $(1,0,1)$ happens with probability $\frac{1}{4}p_R$, in which case second-period welfare is

$$-\left(\frac{p_G + p_R}{p_G + 2p_R}\right)^2 = -\frac{1}{4}\left(1 + \frac{p_G}{p_G + 2p_R}\right)^2.$$

The four cases where $m_2 = 0$ are analogous to the ones above. Hence, the event $(1,0,0)$ happens with probability $\frac{1}{4}p_G + \frac{1}{4}p_L\lambda_L^*$, in which case second-period welfare is

$$-\left(\frac{p_L\lambda_L^*}{p_G + 2p_L\lambda_L^*}\right)^2.$$

The event $(1,1,0)$ happens with probability $\frac{1}{4}p_L\lambda_L^*$, in which case second-period welfare is

$$-\left(\frac{p_G + p_L\lambda_L^*}{p_G + 2p_L\lambda_L^*}\right)^2.$$

The event $(0,0,0)$ happens with probability $\frac{1}{4}p_G + \frac{1}{4}p_L$, in which case second-period welfare is

$$-\frac{1}{4}\left(1 - \frac{p_G}{p_G + 2p_L}\right)^2.$$

Finally, the event $(0,1,0)$ happens with probability $\frac{1}{4}p_L$, in which case second-period welfare is

$$-\frac{1}{4}\left(1 + \frac{p_G}{p_G + 2p_L}\right)^2.$$

Using the above data, we can write expected second-period welfare as

$$\begin{aligned} EW_2^{PI} \;=\; & -\left[\frac{1}{2}p_L\left(1-\lambda_L^*\right) + \frac{1}{2}p_R\left(1-\lambda_R^*\right)\right]\frac{1}{4} - \left[\frac{1}{4}p_G + \frac{1}{4}p_R\lambda_R^*\right]\left(\frac{p_R\lambda_R^*}{p_G + 2p_R\lambda_R^*}\right)^2 \\ & -\frac{1}{4}p_R\lambda_R^*\left(\frac{p_G + p_R\lambda_R^*}{p_G + 2p_R\lambda_R^*}\right)^2 - \left[\frac{1}{4}p_G + \frac{1}{4}p_R\right]\frac{1}{4}\left(1 - \frac{p_G}{p_G + 2p_R}\right)^2 - \frac{1}{4}p_R\frac{1}{4}\left(1 + \frac{p_G}{p_G + 2p_R}\right)^2 \\ & -\left[\frac{1}{4}p_G + \frac{1}{4}p_L\lambda_L^*\right]\left(\frac{p_L\lambda_L^*}{p_G + 2p_L\lambda_L^*}\right)^2 - \frac{1}{4}p_L\lambda_L^*\left(\frac{p_G + p_L\lambda_L^*}{p_G + 2p_L\lambda_L^*}\right)^2 \\ & -\left[\frac{1}{4}p_G + \frac{1}{4}p_L\right]\frac{1}{4}\left(1 - \frac{p_G}{p_G + 2p_L}\right)^2 - \frac{1}{4}p_L\frac{1}{4}\left(1 + \frac{p_G}{p_G + 2p_L}\right)^2. \end{aligned}$$

The terms that do not contain λ_L^* or λ_R^* (i.e., the fourth, fifth, eighth, and ninth terms) can be rewritten as

$$\begin{aligned}
& -\left(p_G+p_R\right)\frac{1}{16}\left(1-\frac{p_G}{p_G+2p_R}\right)^2-\frac{p_R}{16}\left(1+\frac{p_G}{p_G+2p_R}\right)^2 \\
& -\frac{1}{16}\left(p_G+p_L\right)\left(1-\frac{p_G}{p_G+2p_L}\right)^2-\frac{p_L}{16}\left(1+\frac{p_G}{p_G+2p_L}\right)^2 \\
= & -\frac{1}{16}\left(p_G+2p_R\right)+\frac{p_G^2}{16\left(p_G+2p_R\right)}-\frac{1}{16}\left(p_G+2p_L\right)+\frac{p_G^2}{16\left(p_G+2p_L\right)} \\
= & -\frac{1}{8}+\frac{p_G^2}{8\left(p_G+2p_R\right)\left(p_G+2p_L\right)}=-\frac{1}{8}+\frac{p_G^2}{8\left[1-\left(p_R-p_L\right)^2\right]} \qquad (14)
\end{aligned}$$

(here the first equality was obtained by multiplying out the squared terms and simplifying, and the last equality made use of $p_G = 1-p_L-p_R$). The remaining terms can be rewritten as

$$-\frac{1}{8}\left[p_L\left(1-\lambda_L^*\right)+p_R\left(1-\lambda_R^*\right)\right]-\frac{1}{4}\frac{\left(p_G+p_R\lambda_R^*\right)p_R\lambda_R^*}{p_G+2p_R\lambda_R^*}-\frac{1}{4}\frac{\left(p_G+p_L\lambda_L^*\right)p_L\lambda_L^*}{p_G+2p_L\lambda_L^*}.$$

Using $p_R\lambda_R^* = p_L\lambda_L^*$ and $p_R + p_L = 1 - p_G$ and then simplifying, the above expression can be rewritten as

$$-\frac{1}{8}+\frac{\left(p_G+2p_L\lambda_L^*\right)}{8}-\frac{\left(p_G+p_L\lambda_L^*\right)p_L\lambda_L^*}{2\left(p_G+2p_L\lambda_L^*\right)}=-\frac{1}{8}+\frac{p_G^2}{8\left(p_G+2p_L\lambda_L^*\right)}. \qquad (15)$$

From the definition of λ_L^* (see (8)) we have that

$$p_G+2p_L\lambda_L^*=\sqrt{\frac{p_G\delta}{2}\left[1-\left(p_R-p_L\right)^2\right]}.$$

Hence, (15) together with (14) give us the expression for EW_2^{PI} stated in the lemma. □

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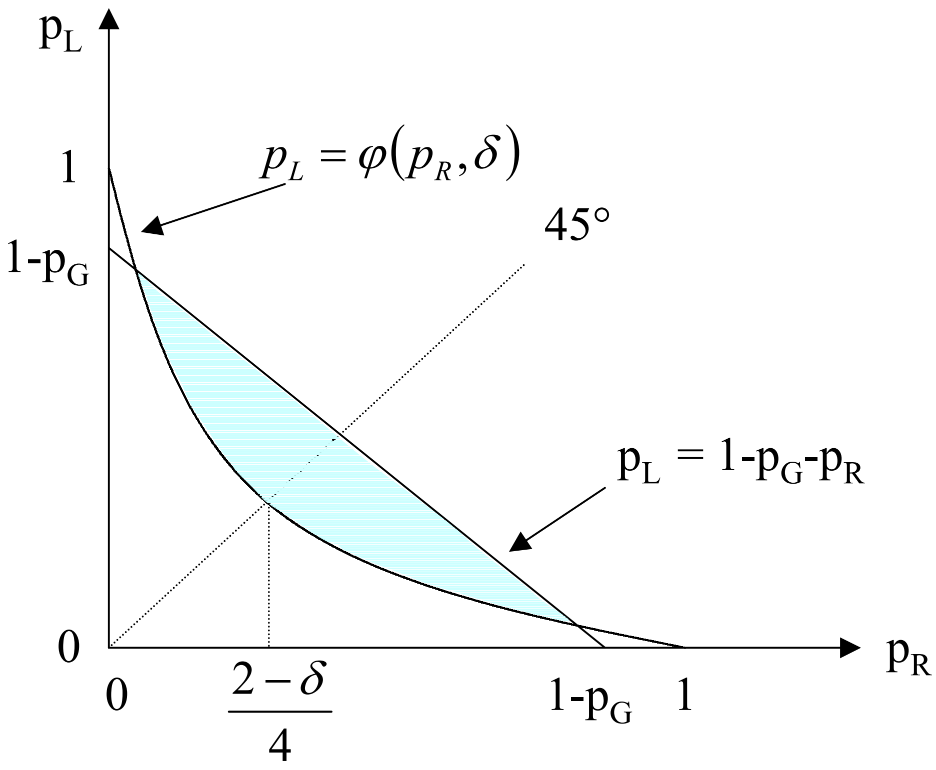

Fig. 1. A partially informative equilibrium exists in the shadowed region.

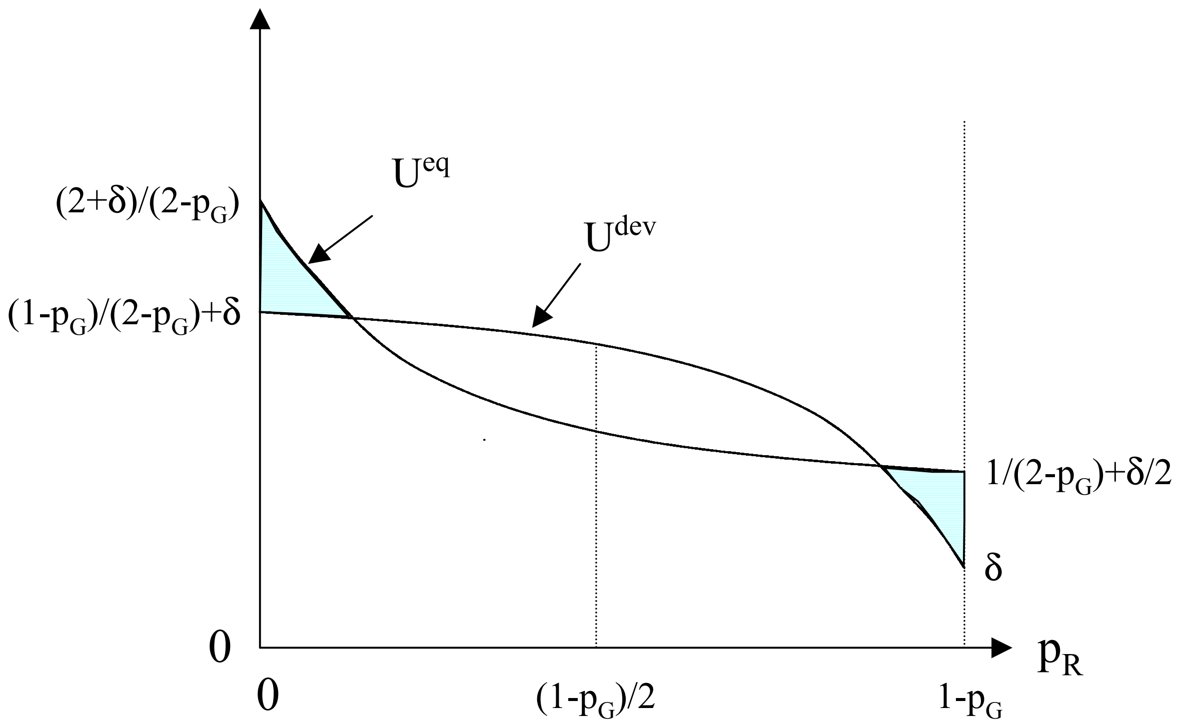

Fig. 2. A non-informative equilibrium exists in the shadowed regions.